THE

ELECTRICAL REVIEW.

VOL. LXXVII. OCTOBER 1, 1915. No. 1,975.

ELECTRICAL REVIEW.

Vol. LXXVII.] CONTENTS: October 1, 1915. [No. 1,975.

	Page
Labour after the War	417
The Copper in German Electricity Works	418
Lead	418
Ought we to Grumble?	419
The Tramway Labour Problem	419
The Municipal Tramways Association	420
The British Association.—IV.	422
Labour after the War	422
Industrial Fatigue	423
The Heating of Iron when Magnetised at very High Frequencies (*illus.*)	423
Transformer Core Loss as affected by Triple Harmonics (*illus.*)	424
Radiotelegraphic Investigations	425
The Capacity of Aerials of the Umbrella Type	426
Gaseous Explosions	426
Exposure Tests of Light Aluminium Alloys	426
The Cadmium-Vapour Arc-Lamp	426
New Electrical Devices, Fittings and Plant (*illus.*)	426
Legal	427
Correspondence—	
Pocket Dry Batteries	427
Telegraph and Telephone Tariffs	427
The A.E.G. Meeting	428
Business Notes	428
London and South-Western Railway Electrification (*illus.*)	431
The Supply of Electricity at Stowmarket (*illus.*)	433
Notes	437
City Notes	440
Stocks and Shares	441
Share List of Electrical Companies	442
Market Quotations	442
The Problem of the "Point-Five" Tariff (*illus.*)	443
Preferential Rates for Exports, by F. Broadbent	444
Trade Statistics of South Africa	445
Arc Phenomena, by A. G. Collis (*illus.*)	446
War Items	447
New Patents Applied for, 1915	448
Abstracts of Published Specifications	448
Contractors' Column	Advertisement page xx

THE ELECTRICAL REVIEW.

Published every FRIDAY, Price 4d.

The Oldest Weekly Electrical Paper. Established 1872.

TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—4, LUDGATE HILL, LONDON, E.C.

Telegraphic Address: "AGEEKAY, LONDON." Code, A B C.

Telephone Nos.: City 997; Central 4425 (Editorial only).

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, 19s. 6d.; Canada, £1 8s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

AUCKLAND N.Z: Gordon & Gotch, Albert Street; The Mining and Engineering Review, 31a, Strand Arcade, Queen Street.

BRISBANE: Gordon & Gotch, Queen St.

CHRISTCHURCH, N.Z.: Gordon and Gotch, Manchester Street.

DUNEDIN, N Z: Gordon & Gotch, Princes Street.

JOHANNESBURG, CAPETOWN, BLOEMFONTEIN, DURBAN, PORT ELIZABETH, &c.: Central News Agency, Ltd.

LAUNCESTON: Gordon & Gotch, Cimitiere Street.

MELBOURNE: The Mining & Engineering Review, 90, William Street; Gordon & Gotch, Queen Street.

MILAN: Fratelli Treves.

NEW YORK: D. Van Nostrand, 25, Park Place.

PARIS: Boyveau & Chevillet, 22, Rue de la Banque.

PERTH, W.A.: Gordon & Gotch, William Street.

ROME: Loescher & Co., Corso Umberto 1° 307.

SYDNEY: The Mining & Engineering Review, 273, George Street; Gordon and Gotch, Pitt Street.

TORONTO, ONT.: Wm. Dawson & Sons, Ltd., Manning Chambers; Gordon and Gotch, 132, Bay Street.

WELLINGTON, N.Z. Gordon & Gotch, Cuba Street.

Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

THE UNIVERSAL ELECTRICAL DIRECTORY

(J. A. Berly's).

1915 EDITION.

H. Alabaster, Gatehouse & Co., 4, Ludgate Hill, London, E.C.

LABOUR AFTER THE WAR.

WHILE the nation is still engaged in discussing what are the best measures to adopt in order to draw men away from their ordinary callings to "do their bit" for the Allied cause, either with the fighting forces or in the factory ranks, it may seem to be premature to enter at all deeply into the probable position of Labour after peace is proclaimed and the clearing-up stage of this colossal holocaust has been reached. Yet the problem is one of such vast importance and of such enormous proportions that it is unwise for its consideration to be long deferred. True it is that we have never had to face such a situation before, and, having little experience to guide us, shall have to shape and reshape our policies with the change of events, but the movements that are taking place in our midst must be closely watched by the most capable minds that can be brought to bear upon the subject. Already we have organisations dealing with the situation, and doubtless our Allies and our enemies are also occupied with it; only a week or two ago we recorded that Germans who were permanently disabled were being taught elementary mechanics. All the leading nations of Europe, and especially the manufacturing ones, will have to deal with the same problem, though in different countries it will take on different aspects. Though our own calls to the fighting line have been numerically less than those of our great Allies, we shall have a large and delicate series of operations to go through before we can return to anything approximating to the industrial state of things that prevailed in July, 1914. Our own problem is quite sufficient to absorb our thought; each nation will have its own particular difficulties. So far as we are concerned, not only has the industry of our Empire been disorganised in order to remedy defects in national organisation, workers having changed from one trade to another and from one locality to another, but the whole citadel of labour principles has been stormed as the result of the attack of Prussianism upon our supposedly sacrosanct individual Liberty. Already disabled soldiers have returned by the hundred thousand; large numbers of them will be permanently unfit for the colliery, the factory, and the works; their experience will, we fear, be multiplied perhaps many times as our brave fellows continue to make their gallant stand; large numbers will probably choose a freer life in the Colonies instead of returning to accustomed industries; hundreds of thousands of others will have made the great sacrifice on our behalf and be free from all the trammels of civilised industry. In these ways the ranks of the industrial workers

will be thinned in comparison with pre-war times. But while the position in Europe continues as it is at present, we cannot see far ahead in regard to these matters. We must go on enlisting and training more men and yet more men, and we must further disarrange ordinary industry in order to increase the output of munitions, leaving it to those who are unable to help in either capacity to bring any special experience or knowledge that they may possess to bear upon the probable or possible effects of present happenings on the course of employment affairs in the years that are to follow. Therefore, it was a wise decision on the part of the British Association to appoint a conference to investigate the "Outlets for Labour after the War." This conference presented an interim report to the Economic Section at the Manchester meeting. The terms of reference were as follows:—

1. To investigate into the replacement of men by women in industries during the war.
2. The permanent effects of this after the war.
3. The character of re-employment with respect to changes of tastes and physique amongst those who have served with the Forces and are disbanded.
4. Suggest means by which consequent unemployment may be counteracted or minimised.
5. Possibility of employing disbanded men on the land.

It was decided that the best method of dealing with the first two terms of this reference would be to investigate those industries in which the extra employment of women since the war had been most marked, as well as those industries in which there were possibilities of an extension of women's work, with special reference to trades localised in the London, Manchester, Leeds, and Birmingham districts.

The last three terms of the reference were left to be dealt with by papers and discussions. The report was, therefore, confined to the replacement of men by women in industries as a result of the war, and the possible permanent effects of this displacement.

We publish a summary of some of the contents of the report elsewhere, and commend the whole subject, of which the employment of women is but a part, to the very careful attention of all our readers.

The Copper in German Electricity Works.

It was recently stated in this journal, on the basis of German calculations, that the Teutons claimed to be in possession of an adequate supply of copper for a number of years in the form of copper and copper alloys, which have been consumed in the country for industrial and other purposes, including electric lighting and power stations and tramway equipment, during the course of many years past. It may now be assumed as a definite fact that numerous manufactures of copper and its alloys have already been appropriated for the use of the munition works, and that with the exception of copper equipment in industrial works acting as auxiliaries of war and the electricity works and tramways, very little of this metal remains available for the use of the army authorities; but the time seems to be approaching when recourse will necessarily have to be had, even to the works which have hitherto been exempt from official levies on materials. If this were not the case we should not find, as was reported from Zurich on September 21st, an important quotation from the well-known *Elektrotechnische Zeitschrift*, of Berlin. This journal, it is stated, has raised a protest against the prospective eventuality of the authorities laying hands on the electricity works owing to the scarcity of copper. It is suggested that the Government should, in the first place, take possession of the roofs of the churches and castles and melt all the bells containing a good alloy of copper, and that other metals should be substituted for the copper tubes of locomotive boilers. It is calculated by the journal in question, that by making the latter alteration 150,000 tons of copper would be realised. The statement made by the Berlin journal is a welcome announcement to this country, as it indicates the difficulties with which the Germans are now becoming confronted in connection with the continuation of the war. But we no longer hear anything of the reported discovery of a substitute for copper, as was announced several months ago at a meeting of a well-known iron and steel association in Germany. The Teutons, it was claimed, did not require any copper, as they had found a substitute; but now the Berlin electrical journal discloses the fact that copper is becoming scarce, and is in urgent request.

Lead.

A distinct and rather sharp upward movement has been seen within the past week or so in the lead market, which has drifted into a rather dull position with less business doing both for home and export. The buying movement, which was responsible for the improved appearance, seems to have been based upon a heavy demand for September shipments to Russia. Dealers here had held a good deal of metal for dispatch to Archangel by vessels leaving British ports during the current month, and it became necessary to provide material in connection with the contracts entered into; some repurchases were necessary also, because metal which had been expected to arrive in time had been delayed. A result of the inquiries thus coming upon the market already poorly supplied with near metal, was to encourage holders to assume a much more resolute attitude, and with prices advancing, speculators who had gone short of the metal were also induced to come forward. For a day or two, the advancing prices in early shipment lead had hardly any effect upon the tendency of forward positions, but even these have now commenced to feel the effects of the more encouraging sentiment, although they still stand at a very substantial discount compared with prompt contracts. The upward turn in the market has come as a complete surprise, for in its early stages it synchronised with a much more accommodating attitude on the part of American holders, who, it is believed, were feeling the weight of the quantities held across the Atlantic, and were desirous of making sales for export. They booked up a number of orders for South America and some other markets, and they also sold about 1,000 tons or a little more for shipment to the United Kingdom, but since the market began to take an upward turn, they have once more withdrawn, although no doubt they are waiting for what they would be disposed to regard as a favourable opportunity of supplying the demands. Additional business could have been done for shipment from America had sellers only been able to secure the necessary amount of freight room, but in this effort they appear to have been unsuccessful. The position generally is one of complexity. Production seems to be pretty ample, in spite of the difficulties in Mexico, but there are recurring periods of vigorous buying, mainly on Russian account, which for the time being are upset by calculations based upon what is believed to be the actual condition of the market.

Ought we to Grumble?

We are quite prepared to make due allowance for His Majesty's Stationery and Printing Department, and the printing firms working in co-operation with it, in these days, and we are in agreement with the Committee which has advocated the introduction of more economical, and, may we say, more efficient preparation and circulation of the thousands of documents that the said department has to produce. But the receipt in this month of September, 1915, of a number of Consular reports for the year 1913 tempts us to be more or less critical in our attitude and to ask of what practical value it is to learn that the supplies of ice from Norway to the United Kingdom fell off very materially because of our cold and wet summer in those dim and distant days before the war, or to receive the interesting information that such and such an electrical undertaking "will be completed during 1914," or to be told that the supplies of eggs exported from Denmark in 1913 amounted to nearly 4,000,000 score more than in 1912? It looks almost as though the Government, which with one hand gave excellent assistance with its material for the capturing of enemy trade, had had to withhold with the other its usual Consular reports, thereby lending some weight to the criticism of traders that after all Consular reports do not matter. We are treated to more up-to-date information respecting the trade of Swatow, in China, for therein we read of what happened in 1914, but when we find that in the interior robbery, piracy, clan fighting and secret society activity produce a feeling of insecurity among the trading classes, we are not enamoured of the trading opportunity, and may be allowed to wonder why Swatow is selected for such expeditious publication, while countries nearer home must wait before their tale is told. From Ichang, in China, too, we are favoured with the 1914 report, but the Consul himself vouchsafes the information that with one single exception "there is nothing of interest to report as regards the trade." What a lot of things there are that, when we really examine into them, "do not matter"! But it were neither kind nor generous to be querulous when the Board of Trade has shown a more real interest in trade affairs, and it were unfair to allot to it blame which is really not its due; the congestion in the Stationery Department, and other difficulties consequent upon the war, doubtless being the actual causes. Perhaps, however, we may be allowed to say that this is one of the things that will want serious looking into "after the war." If we are to have official and complete, and often very useful and interesting, reports prepared by Government representatives for consumption by those engaged in "live" trading operations at home, then it is "up to" those responsible to see that those statements are not hung up so long as to be of, comparatively speaking, little value by the time they appear in print. It looks as though there will require to be a good deal of "speeding up" in these matters when we have finished off our shell and bayonet operations and resumed the battle with the methods of trade competition. Either Board of Trade and Foreign Office reorganisation, long understood to be in hand, or else a Minister of Commerce, seems inevitable unless we are to remain inefficiently served in the matter in question.

The Tramway Labour Problem.

The dominant note of the Municipal Tramways Conference—held last week in London—was undoubtedly the labour difficulty, brought about by the present war. Last year, it may be remembered, the annual Conference, which usually takes place in September, was abandoned in consequence of the outbreak of hostilities, and it is possible that a similar course would have been followed this year, had it not been felt that there were some tramway questions arising out of the war which might be discussed with considerable advantage.

We have now had a year's experience of tramway operation under war conditions, and, generally speaking, the position throughout the country is much more satisfactory than might have been anticipated. Traffic returns are, in many instances, higher than ever previously, due, no doubt, to the increased spending power of a very large section of the working classes as a result of well-known causes; difficulties have also arisen, and, no doubt, will continue to arise, but, so far, they have not proved insurmountable. Principal amongst these are increased cost and difficulty of obtaining labour, increased cost of materials, and increased taxation, and it is to be feared that these will, in too many cases, entirely swallow usual profit margins.

The discussion arising from Mr. Dalrymple's remarks on the tramway labour problem showed that the enforced experiment of employing female labour on our tramways has proved very successful so far; but it is somewhat early to make a definite pronouncement on the subject, as the women have yet to show their physical fitness to meet the exposure of the winter and the continuous muscular strain of ascending and descending to and from the top deck, which falls to the lot of the men, but has so far been largely avoided in the case of the women by allowing fares to be taken on the platforms.

Probably few will doubt the mental capability or nimbleness of the average woman of, say, 30, but her ability to withstand physical strain and exposure, year in and year out, may well be questioned. So far the women have received the same wages as the male conductors (27s. a week at Glasgow), this being a stipulation on the part of the men, who naturally wished to discourage cheaper labour.

But if the experiment succeeds during the coming winter—which is not certain—and if, as at Glasgow, a woman is found capable of looking after a car on the road after only eight days' training, it will be impossible to avoid the reflection that this branch of the tramway service has been even more excessively overpaid in the past than has been generally assumed. Moreover, such inflated rates of pay for the women are unfair to other employers and to the ratepayers generally, since the supply of female labour is greatly in excess of the demand; in Glasgow 800 women have been engaged and 12,000 applications were received, and a similar state of affairs exists in other cities.

It is understood, of course, that the "tramway woman" is a temporary innovation, since the men's jobs are being kept open for them, and so far the woman driver has not made her appearance, although the front platform appears to be sadly in need of recruits, and a woman, if physically fitted, could doubtless be trained for this work as for motor-car driving,

But another matter, which it seems to us is equally as important as this question of female labour and largely bound up with it, is the future rate of pay for tramway work. Many people are firmly convinced that the higher rates of pay introduced since the war will become permanent; some hint that the Budget will result in a further application for an increase in wages owing to the increased cost of living. We have no doubt as to the normal attitude of the labour organisations in the matter, but we believe that economic considerations will override all others; the privileged treatment of any particular section of the population with regard to the financial burdens of the war is surely a thing of the past, and it needs a considerable share of optimism to believe that labour will be as scarce and employment as brisk after the war as they are under the present exceptional circumstances, a creed which those who believe in the continuance of high wages must subscribe to.

We have not here referred specifically to the discussion initiated by Mr. Baker, on tramway finance, and it is only necessary to say that we entirely agree with the common-sense action of both Birmingham and Leicester in increasing their tramway fares sufficiently to meet the estimated financial requirements of the next year or two; we take it that those tramway managers who express disapproval of such a course are satisfied that the profit margin in their particular undertakings is ample enough to meet the strain of the very uncertain period ahead. The only alternative seems to be a call on the rates, which can only be defended in the last resort.

THE MUNICIPAL TRAMWAYS ASSOCIATION.

At the annual Conference of the above Association, which took place on Thursday and Friday, last week, at the Surveyors' Institution, Great George Street, S.W., the Presidential Address, to which we referred briefly last week, was delivered by Alderman H. Linsley, Chairman of the Salford Corporation Tramways Committee, who has filled the presidential office for two years in succession.

Owing to the exceptional circumstances of last autumn, the annual Conference was not held, and this year, instead of holding the meeting at Salford, as would have been the case in the ordinary way, it was decided to meet in London, and restrict the business to discussion of certain tramway questions arising from the war, and to the ordinary business meeting necessary under the Articles of Association.

Of the subjects for discussion, the first, "Tramway Labour Problems as Affected by the War," was introduced by Mr. Jas. Dalrymple, of Glasgow.

Mr. Dalrymple pointed out that there would, no doubt, be very varying conditions in the different tramway undertakings, and that no general experience could be given.

So far as the general staff of tradesmen and labourers was concerned, the war had not in a general way affected the Glasgow tramways. In the car-sheds 129 out of about 512 men had enlisted, and there were 119 fewer men employed now than 14 months ago. Much Government work was being done, and new work was quite stopped; it was impossible to get more tradesmen.

The men had either received increased wages or a war bonus of 2s. per week. Of those engaged in building work, 119 had gone; in the matter of car cleaning, the staff of 635 in August last year was reduced to 472.

The uniformed traffic staff of 3,249 at the same date was reduced to 3,123, and this total included 818 women as conductors. The efforts to engage men unfit for military service had been unsuccessful, and for some time past the staff had had to work seven days a week, and the car services were curtailed. Since March they had got very few men, and therefore relied chiefly on women, but the difficulty was the shortage of motormen.

The working week for the whole staff was 51 hours, and both men and women conductors were paid 27s. per week, but the men received a bonus in addition. About 12,000 women had applied for situations; those selected were from 25 to 35 years of age, about 300 being married women and 55 widows. They had found female conductors very satisfactory, as they were quick, and the passengers were pleased; the latter were encouraged to pay their fares on the platform before going up to the top deck, in order to lessen the work of the women, who had been helped by the men as far as possible. The women had the same conditions of service as the men, but were not asked to work seven days a week; they were employed on all routes, even the roughest ones.

He closed by reminding them that he said nothing of the effect of this work on the health of the women, or of the future; but the women were now doing the same work as the men, and last week they carried more passengers and drew more revenue than ever previously.

Mr. C. W. Mallins (Liverpool) doubted whether female conductors could be safely used on hilly routes, and this was a drawback; they could be used as car cleaners, but the difficulty was what would happen when the men returned. In Liverpool there was plenty of male labour above military age, and his outside staff was composed of men. A question much more important at the moment than female labour, was the utilisation of the resources of the tramways for munition work, and he appealed to the President to utilise the organisation of the Association to this end.

[Both the President and the Hon. Secretary reassured Mr. Mallins on this matter.]

Ald. Dunsford (Southampton) said that in his town, the female conductors who had been put on temporarily had proved a success, but boy labour, which had also been tried, was a failure.

Mr. Wm Murray (Walthamstow) strongly urged the necessity of employing female labour on the tramways in the metropolitan area, where, however, the police had up to now refused to consider the matter. Tramway services had had to be curtailed, and serious overcrowding took place owing to the shortage of men, yet the police authorities stood in the way of employing women. He hoped the Association would take this matter up in connection with the London area.

Ald. Sir J. W. Courtis (Cardiff) said their experience with 50 or 60 women on the cars had been satisfactory, but he disagreed with the employment of too young women or youths. Objections had been raised by the male staff at Cardiff, but they would not have been able to keep going without employing women; these were taking a full share of the duties and receiving 5d. an hour.

Mr. Theo. Prestige (vice-chairman, L.C.C. Highways Committee) suggested that the Association should enlist the aid of the chief recruiting officer in favour of employing women on the tramways of the metropolis, and pass a resolution on the matter.

Mr. T. B. Goodyer (Croydon) said he understood that there was now some hope of the metropolitan police altering their attitude towards female labour on the tramways.

Ald. Brown (Leeds) urged that at the present time serious attention should be given to the question of reducing both labour and working expenses. Although the employment of women had been criticised, he believed they had come to stay, but a difficulty which would have to be faced was the high wages paid; he did not think it right that the woman conductor should receive, to commence with, the same pay as a man, as this might affect all other employers of female labour.

Mr. A. L. C. Fell (L.C.C. tramways) said it was only right to mention that the Metropolitan Commissioner of Police had met them in their efforts to maintain the tramway services, by allowing overloading of the cars. He thought that in any case it would be scandalous to employ women on these crowded cars, but that they should be allowed on outlying routes and in special cases.

Ald. F. Smith (Liverpool) agreed that it was quite time the Association took up the question of tramway labour in London.

Mr. A. R. Fearnley (Sheffield) said there were now 300 women conductors on the Sheffield cars, and more were being taken on; their work was quite satisfactory. Great care was exercised in selecting the women, of whom far too many applied; they were paid at the same rate as the men (6d. an hour), and worked the same hours, and the men offered every assistance. He thought Mr. Mallins was quite wrong in doubting the ability of the woman conductor; in Sheffield they were employed on the hilly routes. In fact, the question was not: could women do the work? but, rather, could they not do it better than it had ever been done before? The women had certain little failings, but the remedy was to employ women inspectors; it had also been found advisable to run staff cars to bring them to work and take them back to the suburbs late at night. In Sheffield they were dealing with a 25 per cent. increase in traffic over last year, and the women conductors were doing this. The shed and repair shop, however, was much depleted owing to munitions work.

Ald. Banton (Leicester) was strongly opposed to employing female labour with an idea of reducing expenses; it would not make for efficiency.

In the end, Mr. Theo. Prestige (L.C.C.) moved a resolution that the meeting should request the executive of the Association to approach the Home Secretary, with the object of removing the present restrictions as to the employment of women as tramway conductors in the metropolitan area.

This was seconded by Mr. L. E. Harvey (Ilford), and carried unanimously.

Mr. Peter Fisher (Dundee), in response to a request by the President, mentioned that in his area female labour was scarce and none was employed on the cars. A third of their employés had enlisted, and others were engaged on Government work, so they took on men over military age, but 60 per cent. of them failed, being unable to accustom themselves to the regular routine. He had come to the conclusion that there was not the necessary male labour to carry on ordinary tramway work.

The President, in closing the discussion, said that at Salford female conductors had given every satisfaction.

In the afternoon Mr. Alfred Baker, Birmingham, introduced a discussion on "Financial Problems as Affecting Tramways During the War."

Mr. Baker said that things had gone well for a number of years with municipal tramways; in many cases large profits were earned and depreciation was provided for, and the position was a sound one. In the early days when the tramways were taken over, tramway committees had dealt generously with the travelling public fares were greatly reduced and other concessions given; but during the past three or four years expenses had gone up materially, and many of them had begun to look at the financial situation even before war broke out, and the position was much worse now. Very large payments were being made to the dependents of men who had joined the Forces. The cost of stores and materials had gone up all round by at least 27 per cent. as compared with 1912-13, while the traffic and permanent-way staff wages showed an increase of 10 per cent., and those of the skilled trades, of 7½ to 12½ per cent. Local rates (at Birmingham) had more than doubled in three years, due to revaluations of the undertaking; and the income-tax, in view of the Budget proposals, might in 1915-16 be £10,000 in excess of that of 1912-13. The net result was a great decrease in the surplus, as shown by the following figures:—

Year.	Receipts.	Expenses, interest and sinking fund.	Depreciation.	Relief of rates.
1912-13 ...	£581,566	£485,794	£45,000	£62,248
1913-14 ...	635,470	567,788	31,000	45,168
1914-15 ...	647,014	604,844	17,596	30,130

It would be noted that although £30,000 had gone to the rates, this should really have gone to depreciation. The financial position at Birmingham was becoming so acute that steps had to be taken to meet it, and it was decided to raise the "selling price." It had been suggested that they should decrease costs, but economies in repairs, &c., only resulted in storing up liabilities. A new schedule of increased fares was, therefore, adopted, and, despite the doubts of some critics, had been quite successful, the receipts per car-mile being for August, 1914, 10·17d., and for August, 1915, 13·18d., an increase of 3·01d.; for June, 1915, the receipts were 11·69d., showing between then and August that there was an increased revenue of nearly 1½d. per car-mile, which amounted to £1,666 per week. It might be suggested that the fares would need to be reduced after the war, but he thought expenses would remain at a

high level after the war. They had raised the price when there was plenty of money about, as there might be a slump after the war; they expected to be from 70 to 80 thousand pounds better off on the year as a result.

Mr. C. W. Mallins (Liverpool) and Mr. Arthur Ellis (Cardiff) both agreed with the policy adopted at Birmingham, but the latter thought it strange that the rates should have received £30,000 before securing the right amount for depreciation. He thought expenses would not go down after the war, and that the fares should be kept up, if they were put up.

Ald. Smithson (Leeds) said it was no use taking a too pessimistic view of the future, there might be a surplus of labour and a slump in wages after the war.

Bailie Alston (Glasgow) agreed with the last speaker; he condemned the subsidising of the rates until indebtedness to the public was wiped out, and expressed astonishment that the Birmingham Finance Committee should interfere with tramways finance.

Ald. Smith (Liverpool) upheld the principle of rate aid, as he considered that the ratepayers who had taken the risks were entitled to some contribution from the tramways.

Mr. McElroy (Manchester) said that from the start operating costs had been going up, and earnings per head of population going down, and he thought they should be careful before agreeing that the correct policy was to increase fares. The tendency had been rather to increase the number of rides.

Mr. C. J. Spencer (Bradford) thought this was the first example of a large undertaking increasing fares as a policy, and it appeared to have resulted successfully. They had had a number of problems before them, and they might only be temporary ones; the tramways were in an extraordinarily successful position, and the future of wages rested on economic considerations.

Mr. Hy. Mozley (Burnley) said his Committee believed in handing over 3½ per cent. to the Finance Committee, which they could apply as they wished; at present depreciation contributions were suspended and the money went to the rates. He did not agree that expenses would necessarily remain at a high level after the war, and suggested that they should take a less pessimistic view of affairs.

Ald. Sir J. W. Courtis (Cardiff) asked what the effect of the present Budget taxation would be. It was possible that they would have an application from the men for a further increase of wages.

Mr. J. B. Hamilton (Leeds) entirely disagreed with the tenour of Mr. Baker's remarks; it would require a great amount of deliberation in Leeds to charge higher fares, if they could get along on the old basis. The revenues of nearly all large tramway undertakings showed considerable increases, and he was not sure that at Birmingham the increase could be solely attributed to the raising of the fares.

Mr. Robson (Southampton) said it was probable that the improved revenue was due to the inflated earnings in the Birmingham district, and that when the Budget effect was felt, travelling would fall off.

Ald. Flint (Leicester) said he thought it was better to make provision now for the future. Despite the upward tendency of receipts, expenses were going up even more, and at Leicester it was considered that 40 or 50 thousand pounds more would be required next year to meet expenses, so they had decided to follow Birmingham's example and raise fares.

Mr. Baker briefly replied to the discussion, pointing out that unless they had been charging passengers much more than they ought all these years, they must raise the fares now.

On Friday morning the annual business meeting was held, when the report of the Council was adopted, and subsequently Mr. Peter Fisher, general manager of the Dundee tramways, was elected president of the Association for the coming year, and Mr. Henry Mozley, of Burnley, was elected vice-president.

The report of the Executive Council, submitted at the annual general meeting, contains the following comparative summary of the members for the past four years:—

	1911-12.	1912-13.	1913-14.	1914-15.
Honorary members ...	1	1	1	1
Local authorities	72	75	75	76
Managers and assistants ...	105	109	111	111

The Executive Council has been approached by the Electric Vehicle Committee, which has been founded under the auspices of the I.M.E.A., and which is affiliated with the Electric Vehicle Association of America, to co-operate with them by nominating a representative to sit upon the Committee, whose main object is to encourage the development of the electric vehicle.

The Council thought it desireable that it should be represented on the Electric Vehicle Committee, and appointed Mr. A. R. Fearnley, of the Sheffield Corporation Tramways, as its representative on this Committee.

The Joint Committee, representing the Municipal Tramways Association, and the Tramways and Light Railways Association, completed its investigations of the question of tramway controllers and their connections so far as they concern magnetic brakes, and submitted a report thereon to the Association.

Mr. A. L. C. Fell, L.C.C. tramways, has been experimenting with a modified arrangement of the controller connections, with a view to overcoming faults existing on the early Dick, Kerr type of controller, used on the L.C.C. tramways, and the following is an abstract of the communication sent to the members as a supplement to the above-mentioned report:—

"As these modifications to a very large extent overcome the faults especially referred to under Group I of the Committee's report, the method adopted may be of interest to your Association.

"Fault.	"Alterations Made.
"(*a*) The terminal boards are fitted in the lower part of the controller with terminals very close together, making it difficult to avoid overlapping of the cables leading thereto, and thus introducing a potential defect in the form of abrasion of the cable insulation.	"The terminals on the finger boards have been removed and special terminals fitted to the finger bases.
"(*c*) The cutting out of one motor from any cause whatever, whether voluntary or otherwise, renders the electric brake entirely inoperative.	"This fault occurs where the motors are connected in cascade for braking, and are therefore inter-dependent on one another. The controller wiring has been rearranged in such a manner that the motors are connected in parallel and equalised, braking with one motor thereby being rendered possible.
"(*d*) Difficulty is experienced in maintaining part of the brake-circuit in a state of efficiency, as magnetic braking was not arranged for in the original design, and certain fingers and segments have had to be added for this purpose in spaces not sufficiently large to ensure the best possible insulation.	"Ample space for the additional fingers and segments required has been obtained by the removal of the terminals referred to under.

"Incidentally, it might be noted that the removal of the terminals eliminates a considerable amount of the controller back wiring and joints, and in addition to the improved braking obtained, a very material reduction in the number of armature and field coil failures is anticipated with the altered controllers."

The Caledonian Railway Co. sought Parliamentary powers to run omnibuses and road vehicles.

The Corporations of Glasgow, Dundee, Edinburgh and Aberdeen, petitioned against the Bill, and the Association undertook to give every possible assistance, and notification was subsequently received that the railway company had decided not to proceed with the clauses relating to motor road vehicles.

The Sub-Committee appointed to deal with motor omnibus traffic, road maintenance, &c., in consultation with the Association's London agents, was informed that the terms of reference of the proposed Committee, composed of members of both Houses, to investigate the question of motor omnibus traffic and road maintenance, were as under:—"That it is desirable that a Joint Committee of both Houses be appointed to inquire into and report as to the present law relating to the running of motor omnibuses and trolley vehicles under statutory powers and otherwise, whether any amendment is necessary with respect to the control to be exercised by local authorities: and what contributions, if any, should be payable towards the cost of road maintenance by the proprietors of such vehicles."

The Sub-Committee decided to communicate with the Association of Municipal Corporations with a view to discussing certain broad principles, and a preliminary Conference has taken place between representatives of the two Associations. A report will be submitted later.

In view of the complaints which have been made as to the alleged excessive damage caused to roads by certain classes of heavy motors and locomotives, the President of the L.G.B. appointed a small Expert Committee to inquire into the sufficiency of the existing requirements with respect to the construction of these vehicles, including weights on wheels, widths of tires, diameters of wheels, &c.

The question whether a special contribution should be paid towards road maintenance by heavy motor users was outside the scope of the Expert Committee.

The Income-Tax Sub-Committee has had under consideration the question of the proper allowances for depreciation of motor omnibuses. It was felt both in the interests of the Board of Inland Revenue and the Associations concerned, that a uniform method of determining depreciation allowances for income-tax purposes to govern the practice for the future should be arrived at, as in the case of tramways. A Special Committee was appointed to investigate this matter, and certain recommendations were adopted which will be placed before the Inland Revenue Authorities in due course.

At the time of writing, 16,630 men, or 30 per cent. of the employés on municipal tramway undertakings, have joined His Majesty's Forces.

In addition to enlistments, a further drain has taken place in the ranks of skilled artisans engaged upon the repair of tramcar equipments, and it was deemed necessary to draw the attention of the Minister of Munitions to the fact that the efficiency of tramway undertakings was being seriously affected, and point out that it was necessary for a certain number of specially skilled men to be retained if the tramways of the country were to be kept in a safe and efficient running condition, and that in many towns munitions were being manufactured, and any interference with the tramway service would have a very serious reactionary effect upon the output.

With this point of view the Minister of Munitions agreed, and, he is considering, in consultation with the War Office, whether it is possible to protect tramways against the loss of any of the irreducible minimum of skilled workmen, required for the proper

working of the tramway service, by means of the issue of badges under Sec. 8 of the Munitions of War Act, 1915.

The Minister states that he is addressing a further communication upon this matter, as it appears somewhat doubtful whether work in connection with tramways can be strictly regarded as being work for war purposes, within the meaning of the Section of the Act above referred to.

The Sub-Committee of the Engineering Standards Committee on Tramway Rails has had under consideration (1) the revision of the Standard Tramway Rail Sections; (2) the revision of the Standard Specification for Tramway rails; and (3) a Report on British Standard Special Trackwork for Tramways.

The Sub-Committee proposes to recommend that the existing Standard Sections be replaced by three sections, with their corresponding curved sections, having a uniform width of head of 2⅛ in.

It also proposes to recommend the adoption of a dwarf rail for inter-urban tramways. This rail is primarily intended for use with sleeper construction, has a 2⅛ in. width of head, and weighs about 88 lb. per yard.

A Panel Committee has been at work preparing recommendations for the revised analysis and mechanical tests for tramway rails. It has presented its report to the Sub-Committee and the revision of the Standard Specification is being proceeded with.

A report has been prepared on British Standard Special Trackwork for Tramways, dealing with the standard nomenclature of the different classes of special trackwork used in actual practice, and standard dimensions for crossings, switches and turn-outs.

The Engineering Standards (Panel Committee) on Tramway Tires and Axles has drawn up standard specifications for tramway tires and axles. In the case of tramway axles the same course has been taken as was adopted in the railway rolling stock specifications, two specifications being drafted, one with and one without a chemical analysis, in order that those who do not desire to specify an analysis may have a standard specification available.

Pending the confirmation of contain cold bend tests for axles, the specifications are ready for presentation to the Sub-Committee on Tires, Axles and Springs.

In order that the undertaking of experiments and the general investigation of the rail corrugation phenomena might proceed continuously, the General Committee decided to appoint two Sub-Committees, one comprising the members in the North and the other those in the South, to undertake this work.

THE BRITISH ASSOCIATION.—IV.

Labour after the War.

We refer to the report in this matter in our leading columns. The report summarises the position that women's employment has taken during the year, August, 1914, to August, 1915. At the end of this section the following reference is made to the "present effects of war on industry":—

The women who have entered industry since the war seem for the most part comparatively young. Billeting money and fairly liberal separation allowances have in the majority of cases been sufficient to prevent any large number of married women from returning to their trades.

One of the tendencies of the war is clearly to transfer a more than normal proportion of the nation's business to large concerns. Though this has its drawbacks, the balance on account is probably to the advantage of the women who have entered, as far as the safeguarding of their standard of life is concerned, and consequently of that of the men who will return.

It is clear that the year has seen an enormous upheaval in industry; factories have been adapted to meet new demands and to facilitate women's employment; trade union and Home Office restrictions have been relaxed; women are replacing men; experiments are being made and knowledge gained which may well revolutionise many branches of industry. The one great factor upon which industry as a whole now depends is the volume of Government contracts. At the end of the war these will substantially decline and industry will begin to resume its normal course. But every transference of labour, every youth put into a man's place, every woman who has received training, because of the war, adds something to the bewildering chaos of those industrial problems which will have to be grappled with when peace is declared.

Section II considers the general position and indicates the main features arising out of the new conditions of women's employment during the past year. Three features of the labour market that stand out in special prominence are:—

1. The serious shortage of skilled workpeople.
2. The considerable extension of women's employment.
3. The limited extent to which women have replaced men, in the sense that women are now doing work previously done by men.

The first of these is not only due to enlistment but also to what in the past thirty years has, unfortunately, been a growing feature of industry—the small proportion of skilled to unskilled industrial workers. This disproportion is exceptionally large amongst women. The shortage of skilled labour is the cardinal feature of the industrial position with which the nation is now faced. The situation cannot be solved during the present time of war. In a great many industries women are working on processes previously wholly or partially done by men, but the extent to which this has occurred is inconsiderable. The margin of difference, however, between actual fact and possibility is yet to be discovered, but that is largely a matter for the future—in a small measure for the year immediately in front of us, but chiefly for the years of construction and renewed effort which will follow the war. The report later considers the important question of the training of skilled labour, and discusses the relative functions of the technical school and the workshop in the training of the artisan. In the metal working trades, and in some others, the whole of the highly skilled workers are men. The women employed in these trades are either semi-skilled or unskilled. The question arises whether women are capable of becoming highly skilled workers, and, if so, whether they would in normal times be preferred to men. This depends on a variety of circumstances, physical, psychological, economic, and social. Some engineering employers express a doubt as to whether women could be trained to the same degree of skill as has been attained by highly skilled men, maintaining that women lack, as a rule, the necessary qualities of judgment and initiative, and dislike shouldering responsibility. The question of the possible limitations to the industrial employability of women is gone into at some length, and such matters as wages are also discussed, but the space at our disposal prevents us from entering fully into the rest of the report, though we have no doubt that as a whole it will be perused with interest by employers, social economists, and other students of the times and tendencies. Particular professions, callings and trades have been made the subject of full inquiry, and from the material contained in the remainder of the pamphlet (more than 80 pages) we reproduce merely the section bearing on "electrical apparatus," the investigation in regard to which was made by Miss M. E. Bulkeley, Miss M. Cross, and Miss Moses:—

	1901			1911		
	Total	Men	Women	Total	Men	Women
Electric cable manufacture	—	—	—	5,813	4,858	955
„ lamps	49,518	47,028	2,490	5,627	1,425	4,202
Other electric apparatus and electric fitters ...	—	—	—	54,746	50,558	4,118
				66,186	56,841	9,275

[The men's figures for 1901 include also electricians (undefined) who in 1911 equalled 27,905.]*

Women are to some slight extent doing work which before the war was done by men, in certain departments such as:—

Small lathe work.
Screw machines.
Cable making.
Winding of transformers for armatures.

This last may be regarded as an extension of work previously done by women rather than as an entirely new process; for example, where they now wind two coils on to a transformer they previously only did one.

Before the war, women were definitely employed in all branches of light work in electrical apparatus work, but not at all in the electrical supply trade. Although the above displacement is classed as owing to the war, there is evidence that before August, 1914, the policy of many firms had been to extend the employment of women into new branches. That women have to some extent been replacing men, or, at any rate, entering new branches, may also be inferred from the fact that, though the electric lamp branch of the trade has been depressed owing to the war, there has been a total increase in the employment of women in the electrical trade of nearly 18 per cent. Part of this increase is due to a temporary increase of production in branches of the trade in which women were previously employed, but as the enlistment of men from this trade has been on a considerable scale, it is reasonably clear that women are to some extent taking their place during the emergency. In most cases readjust-

* The table is reproduced as it stands in the original; apparently the 1901 figures are the totals.—Eds.

ment to meet the introduction of women has been simple, or no alterations at all have been necessary, as they have only been put on to the lighter machine work. One firm has actually made the machines more mechanical and employs an extra mechanic as supervisor.

The introduction of women into new processes often necessitates the provision of another workshop, as in the majority of cases it is not considered desirable for men and women to work together.

The main objections to the employment of women are :—

1. Want of technical skill and general experience.
2. Want of physical strength, making it impossible to employ women on the heavier processes.
3. The strong objection on the part of many employers to have men and women working side by side in this trade.
4. In some cases the men's objection to the introduction of women.

In regard to the question of physical strength, one firm employing women in lathe making found the women's output slightly less than that of men, owing mainly to exhaustion during the last hour of work. Nevertheless, it is clear that as a general rule women's output is considerably less than that of men, since both on time and piece rates their wages are generally 50 per cent. below those of men.

The main advantages are :—

1. Their greater dexterity in certain processes where small fingers are an advantage. This has been a considerable factor in the employment of women in such processes as assembly work in the electric lamp trade.
2. Cheapness of their labour.
3. The larger supply of unskilled workers to draw upon.

The Future of the Trade.—In those processes which are suitable to women, the possibilities of extending their employment are great. In the more skilled processes, however, where a longer training is necessary, it depends how far women choose to utilise the present opportunity of becoming highly efficient workers. Hitherto women have been employed almost entirely in unskilled processes, and the trade has been essentially one for young persons, the majority of the girls leaving the trade soon after the age of 19. It is difficult to foretell the state of trade after the war, but in view of the accumulation of private work which cannot be done at present, employers rely on its being good for at least a year or two, and they, therefore, expect to absorb the men returning from the Front as well as the new women that have been taken on. Two firms stated that after the war it was much more likely to be a case of taking on new men in addition, than of dismissing the new women.

On the whole, there is little definite evidence up to the present of the actual displacement of men by women owing to the war, and the increase in the number of women is mainly due to a temporary increase of production. The trade unions, however, state that of recent years there has been an increasing tendency to bring women into the trade, and in view of the fact that women are unorganised, they are pessimistic with regard to the future, fearing that the increase of female labour will lead to a fall in the standard of wages, and to male unemployment after the war. Much will depend upon the attitude of the women themselves.

Industrial Fatigue.

The report of the Committee on Industrial Fatigue was also received by the Economic Section.

In the course of the discussion on the report, Prof. Kirkaldy, who was in the chair, referred to Mr. Lloyd George's speech at the Trade Union Congress, in which regrettable incidents on the part of the workers were mentioned. Prof. Kirkaldy said it seemed to him that some of the unrest and some of the diminution of output was due to the fact that our Labour force was improperly organised. He was certain we should not get the best results from our munition workers until the subject of fatigue had been properly considered, and the workers' time and energies so organised that they got proper leisure and proper recreation.

Dr. T. M. Legge (Medical Inspector of Factories under the Home Office) said he had been struck by the wonderful spirit of the workers, and in his opinion it was that that sustained them in their additional work. His experience was that where there was no fast-running machinery there were no obvious signs of fatigue.

A rather pithy sentence from the speech of Prof. B. Moore ran something as follows: Over-working of men might have been excused when we thought we were in for a hundred yards' race in this war; but we now found it was a four-miles' race, and must organise the workers accordingly. We ought to organise on the lines of putting more men on the work. Far more work was done in three eight-hour shifts than in two 12-hour shifts.

The Heating of Iron when Magnetised at very High Frequencies.

By N. W. McLachlan, B.Sc., A.M.I.E.E.

(*Section G.—Abstract.*)

The present paper is the outcome of tests made by the author to ascertain the magnetic behaviour of Stalloy and Lohys at very high frequencies, using a Poulsen arc generator. Tests have been carried out at frequencies between 3×10^5 and 5×10^5 periods per second. Although the "apparent" maximum flux density is small, owing to the screening effect of eddy currents, the rate of rise of temperature of the iron is very large on account of the high frequency of the magnetising current producing correspondingly large hysteresis and eddy-current losses.

Theoretically the eddy-current loss (which is the larger of the two at such high frequencies) for a given thickness of plate and number of turns per centimetre length, is proportional to the square root of the frequency, specific resistance and permeability, and to the square of the magnetising current. Moreover, since the frequency of the oscillations in the shunt circuit of the generator increases with the current* (for a given value of the capacity), and the loss increases as the square root of the frequency and the square of the current, it was essential, in order to obtain a large heating effect, that the current should be large.

The Poulsen arc generator circuit is arranged as shown in fig. 1. The field-magnet coils producing the magnetic blast are in series with the copper-carbon arc, which burns in an

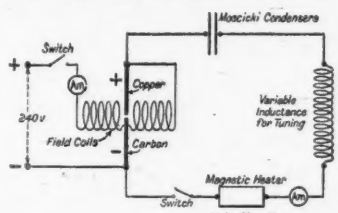


Fig. 1.—Arrangement of Poulsen Generator Circuit.

atmosphere of coal gas. The air gap between the poles of the magnet is 19 mm., and the electrodes are each 15 mm. in diameter.

The oscillatory or shunt circuit is connected across the arc and consists of one or more Moscicki condensers and a plate-glass condenser, a variable inductance for tuning to the desired frequency, a magnetic heater (to which reference is made hereafter) or other apparatus for demonstration purposes, and an ammeter to read the current.

In order to ascertain the frequency a loose coupling is made between the variable inductance and the coil of a Lorentz wave-meter. The wave-length is then determined by adjusting the variable condenser of the wave-meter until resonance is obtained.

By using various wave-meter coils, it is possible to analyse the current in the shunt circuit. If the coil constants are known, the relative magnitudes of the fundamental and the various harmonics can be determined. The most prominent harmonics are the second and third. Since there is an even harmonic, the positive and negative half waves are not similar. However, by adjusting the arc length so that the current through the arc is as large as possible for steady burning, the harmonics may be reduced.

The heater, fig. 2, consists of a glass tube 1¼ in. in diameter on which is wound 20 turns of 22 s.w.g. The tube contains a bundle of iron strips or wires and also a quantity of water. The ends of the tube are plugged by means of rubber corks.

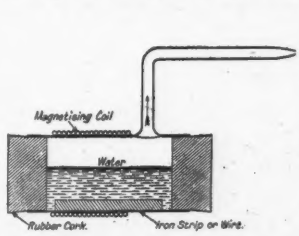


Fig. 2.—Magnetic Heater.

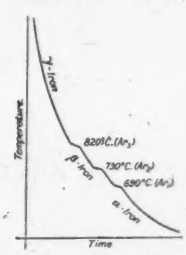


Fig. 3.—Cooling Curve for Mild Steel.

In order to demonstrate the losses in the iron, one of the heaters is inserted in the shunt circuit (fig. 1). A short time after the current in that circuit is switched on, the water begins to boil. Thus the iron strips when magnetised act in a somewhat similar manner to the fire tubes in a locomotive boiler.

Another form of heater, by means of which water can be boiled, consists of a coil of wire wound on an iron tube.

The sizes of the heaters are limited by the power available from the Poulsen generator.

At such high frequencies, viz., 3×10^5 periods per second and over, the accurate determination of the losses in the iron is a very difficult matter. It can be shown experimentally that, for values of the "apparent" magnetising force from 2 up to 6 c.g.s. units, no serious error is involved in taking the watts lost as the product of total current through the circuit and voltage due to the iron alone. Several coils, some having

* When the inductance in the shunt circuit decreases the current and frequency increase, and *vice versa*.

cores of Stalloy and others of Lohys, have been constructed in such a manner that the effect of the non-ferric portion of the core and the IR pressure-drop is negligible, and the watts lost per kilogram obtained in this way.

By using a modified 3-voltmeter method of measuring power and assuming the voltage to be sinusoidal, it may be demonstrated that the power factor for the coil is nearly unity. Thus the energy current is practically equal to the total current, while the true magnetising current is a fraction of the latter.

The losses in the iron might also be estimated by lagging the heater well to minimise radiation, and passing a quantity of water through in a certain time, maintaining the inlet and outlet temperatures constant. Provided the difference of temperature was fairly large, say, 30 deg. C., the watts lost per kilogram ought to be obtained fairly accurately. This procedure could only be adopted in cases where a sufficient rise in temperature was obtainable.

The Recalescence Point Ar_1.

When iron is heated above a temperature of about 700 deg. C., *i.e.*, above the point Ac_1*, it passes from the alpha-state to the beta-state. The former is magnetic while the latter is non-magnetic. Just before reaching the point Ac_1, the permeability, provided the magnetising force is weak, say, 0.4 C.G.S. unit, increases very rapidly for a comparatively small increase in temperature, attains a maximum value somewhat after the nature of a resonance curve, and then suddenly drops to unity when the iron reaches the non-magnetic state. This is illustrated in fig. 4. For stronger fields, say, 4.0 C.G.S. units, the increase in permeability is comparatively small. This case is illustrated in fig. 5.

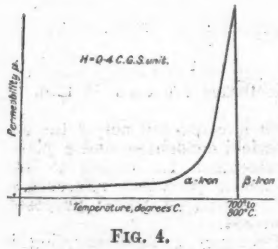


Fig. 4.

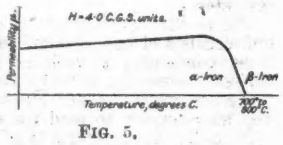


Fig. 5.

Permeability-Temperature Curves.

The following experiment illustrates the increase in permeability up to a certain temperature and the decrease at higher temperatures:—

A ring of Lohys, of 4 in. external diameter, 3¼ in. internal diameter and 0.36 mm. thick, is covered on both sides with asbestos rings and wound with copper wire. In order to prevent short-circuiting on the iron, the wire is wound lightly and the whole ring squeezed up in a vice, thereby diminishing the thickness. This procedure also lessens the area of the non-ferric portion of the ring, which must be as small as possible if quantitative results are to be secured, owing to the small apparent permeability of the iron at such very high frequencies. The ring is connected up in the oscillatory circuit of the Poulsen generator with a voltmeter across its terminals.

When the current is switched on in the shunt circuit it attains a certain value. At the same time the voltmeter records the value of the voltage across the coil. The temperature of the iron increases rapidly until a point is reached,† when the current falls steadily and the voltage rises until both become stationary. On the attainment of a still higher temperature the current rises until it reaches a definite higher value. When the current increases, the voltage decreases until it attains a steady value.

The first decrease of current, with its corresponding increase in voltage, is due to augmentation in the apparent permeability caused by rise in temperature. The subsequent rise in current, with its corresponding decrease in voltage, is due to diminution in the apparent permeability caused by a still further increase in temperature.

The approximate figures given below will enable the changes to be followed more easily:—

B_{max}, apparent.	H_{max}, apparent.	μa apparent.	Watts per kilogram.‡	Frequency per second.
3,500	21	170	48,000	$1{\cdot}9 \times 10^5$
4,300	17	250	44,000	$1{\cdot}7 \times 10^5$
3,200	25	130	57,000	$2{\cdot}1 \times 10^5$

*Ac_1 is that point on the heating curve of iron corresponding to the recalescence point Ar_1 on the cooling curve. Fig. 3 shows the nature of the cooling curve for mild steel containing 0.02 per cent. carbon. In this case there are three recalescence points or points of arrest, viz., Ar_3, Ar_2, Ar_1.

†The iron being red-hot.

‡The author has not ascertained if the foregoing method of estimating the losses, viz., product of volts on coil and amperes through it, holds for frequencies lower than 3×10^5 periods per second, and apparent magnetising forces greater than 6 C.G.S. units. Moreover, in adopting this procedure in the present instance the losses may be too large.

B_{max} calculated on the assumption that the magnetism is uniformly distributed across the section gives an "apparent" value, while H_{max} calculated from the total current is not the true magnetising force, since the true magnetising current is a fraction of the total current.

In calculating the above quantities the wave forms of the current through the coil and the voltage across its terminals have been assumed to be sinusoidal. If the current wave was sinusoidal, the E.M.F. wave would be peaked, and the form factor greater than 1.11. This would mean a reduction in the apparent values of B_{max} as given in the table.

An inspection of the table shows that the apparent permeability increases 30 per cent. with rise in temperature up to a certain point, the watts lost per kilogram decreasing 9 per cent. For a further rise in temperature the apparent permeability decreases 50 per cent., its value being lower than that at normal atmospheric temperatures, while the watts lost per kilogram increase 30 per cent.

Transformer Core Loss as affected by Triple Harmonics.

By H. M. Lacey, B.Sc., and C. H. Stubbings, B.Sc.

(*Section G.—Abstract.*)

This paper described experiments conducted in the Siemens Electrical Engineering Laboratory, King's College, London. The object of these experiments was to investigate the effect of triple harmonics upon the core losses in transformers.

An alternator giving approximately a sine wave was three-phase star connected to a three-phase choking coil. The star centres were also connected through a switch. Current-measuring resistances were inserted in the neutral and one of the outer leads. Voltmeters and ammeters were also inserted as required. Two experiments were made:—

(1) With the switch in the neutral wire open.
(2) With the switch in the neutral wire closed.

In each case the wave forms of phase amperes, phase volts, and in the second case amperes in the neutral wire, were taken by means of a Kelvin quadrant electrometer and a contact-maker.

The curves thus obtained were remarkable in many ways. In a balanced three-phase star system, the algebraic sum at any instant of the currents in the three arms will equal three times the value at that instant of the third harmonic in one of the arms, neglecting higher harmonics. It is thus obvious that in the first case, where the centre of the star is insulated, the presence of third harmonics would be a direct contravention of Kirchhoff's First Rule. The accuracy of this conclusion is clearly verified by the experimental results, for an analysis of a mean curve drawn to exclude the ripples or higher harmonics gave (Case I) the following:—

Volts:

3rd harmonic, 48.9 per cent.; 5th harmonic, 4.12 per cent.

Amperes:

3rd harmonic, 3.6 per cent.; 5th harmonic, 21.1 per cent.

Thus we see that while the triple harmonic in the current curve is (within the limits of accuracy) completely suppressed, it is very pronounced in the volt curve.

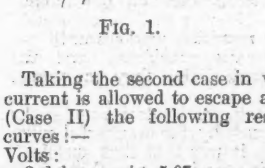


Fig. 1.

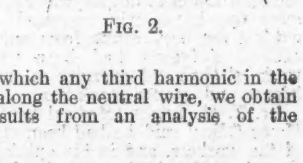


Fig. 2.

Taking the second case in which any third harmonic in the current is allowed to escape along the neutral wire, we obtain (Case II) the following results from an analysis of the curves:—

Volts:

3rd harmonic, 5.07 per cent.; 5th harmonic, 2.88 per cent.

Amperes:

3rd harmonic, 48.2 per cent.; 5th harmonic, 13.94 per cent.

Also the wave of current in the neutral wire was practically a pure sine wave of triple frequency, thus amply justifying the statement that the triple harmonic escapes along the neutral wire. Its amplitude was also found to be approximately three times that of the third harmonic in the current curve. It is very significant also that the percentage triple harmonic in the volt curve in Case I is practically the same as that in the current curve in Case II. It would, therefore, appear that the triple harmonic is inevitable, and if suppressed in the current curve is forced into the volt curve.

Fig. 1 shows the wave-forms obtained when the centres of the stars were insulated. The volt and current curves are marked v and i respectively, and the induction curve was obtained by integration of the volts, copper drop being negligible. The presence of the third and fifth harmonics in the volt and current curves respectively can be clearly seen from the diagram, the third harmonic causing the volt curve

to descend below the zero line at one point. Fig. 2 gives the wave forms obtained with the switch in the neutral wire closed. The third harmonic is very pronounced in the current curve, and the current in the neutral wire is represented by the dotted line.

The question now arises as to what effect this will have upon the hysteresis and eddy-current loop for the iron cores of the choking coils.

Fig. 3 shows the loops obtained from the curves; these are not in B and H units, but they are both drawn to the same

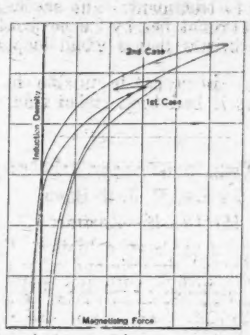


Fig. 3.

scale. The extraordinary shape of the loop for Case I is largely due to the triple harmonic in the volt curve.

The following readings were taken:—

Case I.—Line volts, 185.5; magnetising current per phase, 3.9 amperes.

Case II.—Line volts, 186.6; magnetising current per phase, 4.88 amperes.

Value of B_{max} in Case II is 1.144 times the value in Case I.

In order to compare the core losses in both cases, the areas of these loops were found, and are in the following ratio:—

Area of loop 1 = 0.775 × area of loop 2.

It will thus be seen that a saving of 22.5 per cent. in the core loss is effected by insulating the neutral point. The actual value of B for this percentage saving was not actually determined, but the shape of the loops obtained indicates a value of B_{max} for Case II of approximately 15,000.

Each reading on the volt curve was multiplied by the corresponding reading for the current, and the average watts thus found for each case. These watts are dissipated in core loss, copper loss being negligible, and they were found to be as follows:—

Case I, 54.2 watts. Case II, 71.5 watts.

The ratio of the losses thus obtained gives the value 0.757, which is sufficiently near the figure obtained by the other method to justify the supposition that this is correct.

The experiments thus show that the losses in a transformer are considerably reduced by employing an insulated neutral point. Also, they may be made to give the same voltage with a smaller value for the induction density.

Radiotelegraphic Investigations.

(Section A.—Abstract.)

The report of the Committee shows that the war has had a very direct effect on radiotelegraphic investigations. About the beginning of August, 1914, private wireless telegraph stations throughout the Empire nearly all stopped collecting statistics, while naval and other Government stations stopped all merely scientific observing. A few stations in India, Australia, Canada, the West Indies, and the United States are, however, still at work.

The fact that the Committee's programme for the collection of statistics three days a week in all parts of the English-speaking world, and in a few other countries, has been interrupted after only three months of work diminishes greatly the scientific value of such statistics as have been collected. It also implies considerable financial loss. The extensive scheme of special observations projected for the occasion of the solar eclipse failed almost completely in the countries in which the eclipse was visible.

The day-by-day statistics collected in the period April to July have been partially analysed. The conclusions drawn from these observations yield information which will guide the Committee, when the time comes, to further attacks on the problems concerned.

Analysis of Records of Strays.—The principal and most universal fact is that the strays heard in the dark hours are much more numerous and louder than those heard during daylight. If curves be drawn showing the amount of disturbance to telegraphic work from hour to hour, the lowest point usually falls a little after mid-day, and the highest point of the convex part of the curve occurs a little after midnight, in nearly all stations north of the Equator. Unless local weather conditions are producing great disturbance, the change from night to day conditions and *vice versa* in stations north of the Equator lags behind the sunrise and the sunset. At some stations south of the Equator, *e.g.*, Cocos Island, the opposite rule seems to be usual.

Periods of Excessive Disturbance.—Occasionally the radiotelegraphic work at a station is rendered almost or quite impossible for a period, by strays of vigour and number greatly exceeding the average. These occurrences are for brevity called "X storms," the term "X" being an alternative designation for "stray" or "atmospheric." An analysis of the records has shown that X storms occur within the same two or three days over very wide areas. Occasionally X storms are reported almost simultaneously at places several hundred miles apart, but more usually the X storms occurring at such distances are separated by several hours. Periods of severe strays coincide with periods of low barometer, high wind velocity, rapid change of temperature, great rainfall, and, especially, rapid barometer fluctuations. These meteorological conditions are precisely those that accompany or precede thunder storms and line squalls; and, in fact, the records of the Meteorological Offices, and of the observers reporting to the Committee, all lead to the conclusion that X storms are often associated with thunder storms at places not very far distant. Sometimes all the symptoms of thunder weather except thunder and lightning may be present in a locality and a heavy X storm be recorded.

It is well known that the unstable atmospheric conditions bringing thunder weather sometimes move at a relatively slow rate from place to place, and may have their movements traced by ordinary methods of meteorology. The analysis of the radiotelegraphic records shows that such convective weather can be anticipated several days in advance.

A report received from the wireless-telegraph station of the Government of Australia situated at Esperance states that during the day-time rain is preceded in at least 80 per cent. of cases by intermittent disturbances. Strays of varying strengths may be heard from 6 a.m. to sunset for one or more consecutive days prior to rain.

This conclusion is borne out in other ways by some of the records forwarded to the Committee. There is evidence that north-west winds on our Atlantic coasts, especially in the winter, are associated with strong strays at Irish stations and at sea. The atmospheric convection produced by the land may be sufficient to account for this. Mr. R. Ricci, of the Marconi Co., who has made reports on two trips round the world, during which he made especially careful daily observations, states that in mid-ocean strays are, as a rule, very few and feeble both in the day and in the night; but that when the edge of a mountainous continent is approached strong, and even continuous, strays are normal. In this something must depend on the direction of the prevailing wind relative to the land—a matter that will be inquired into later.

The months of the greatest X storms in the Mediterranean are shown by the records to be September and October, the months of cyclonic weather.

As a whole the statistics show that there appear to be two kinds of X storm occurring in the day-time: (1) Those produced by convective conditions in the atmosphere within, perhaps, a hundred miles of the station, which may be termed local X storms; (2) those originating at a distance. Regarding the first class, in general, we may conclude that the observation of strays in the day-time constitutes a method of feeling the fringe of a region of convective weather, and so anticipating thunder and rain a day or two in advance. This ability to prophesy the advent of thunder weather is well known and is as old as wireless telegraphy itself; but hitherto it has been thought that the electric discharges at a great distance were responsible for the strays heard at the station attempting to prophesy. The present analysis indicates, rather, that at any rate in the day-time the strays are frequently due to very local discharges, often too weak to give noticeable lightning or thunder, but definitely indicative of an approaching period of instability in the atmosphere.

The second kind of X storm is not of strictly local origin, but is sometimes traceable in the stray observations made hourly at the Malta station of the Eastern Telegraph Co., and the Sierra Leone station of the African Direct Telegraph Co. There is evidence that on certain occasions the same cause is affecting both stations though they are separated by 2,500 miles, mostly across mountain and desert.

As regards disturbances observed at night-time, these are also frequently very local and due to convective weather, but there is probably a greater proportion of non-local storms than appears in the day records. In this connection may be noted a report from Australian stations that the worst and most continuous type of disturbance (apart from local thunder storms) occurs on calm nights when the sky is blue and starry.

As a contrast to the prevalence of strays during convective weather may be instanced the fact, reported by Lieut. E. R. Macpherson from Sierra Leone, that a very dry wind which blows periodically for several days on the West Coast of Africa causes an almost complete cessation of strays immediately it starts and allows of their resumption immediately it stops. On the other hand, the monsoon period on the same coast is one marked by great X storms.

Graphic Records.—Many observers have made for the Committee precise observations of individual strays by making, on lines graduated to represent time, marks corresponding to each stray as heard in the telephones, the zero of time being fixed by aid of radiotelegraphic time signals within range of the observer. Comparison of the records made in the British Isles has shown that on an average night many of the strong

strays are heard by all the observers, and on days free from X storms the same remark applies. Coincidences have also been noticed between pairs of American stations not too widely separated. The analysis for very distant stations has not yet been carried out except for a very few in Europe. For example, in the month of June, 1914, coincidences have been traced in the strays heard at Southampton and Dresden, Gibraltar and Dresden, Guildford and Malta. A proper investigation of the meteorological conditions accompanying or determining the periods when strays are heard simultaneously at places very wide apart has not yet been made.

Auroral Displays and Magnetic Variations.—Reports from officers in the wireless telegraph stations of Alaska show that the appearance or disappearance of auroræ caused no unusual disturbances. No trace of the 27-day period of magnetic variations or of any nearly equal period has as yet been found.

The Capacity of Aerials of the Umbrella Type.

By Prof. G. W. O. Howe, D.Sc.

(*Section G.—Abstract.*)

In a paper read before the British Association at Sydney last year the author developed a method of calculating the capacity of radio-telegraphic antennæ. In addition to describing the method in general, curves and formulæ were given so that the capacity of aerials of standard types could be determined in a few minutes. The umbrella type, however, was not specially considered, and it has since been suggested to the author that the usefulness of the paper would be considerably increased if curves and formulæ could be given for aerials of this type. The method is briefly as follows:—The whole aerial is assumed to have a uniformly distributed charge, and the average potential of the whole aerial under this fictitious condition is then calculated. It is assumed that if the total charge, while remaining unchanged in quantity, be allowed to have its own natural distribution, it will assume a uniform potential approximately equal to this fictitious average potential. The proximity of the earth is taken into account by the method of images. Tables and curves are given for aerials with from two to six ribs and for various angles between the ribs and the vertical. With these curves and those given in the original paper, each of the nine component potentials of any given aerial of the umbrella type can be read off and the resultant average potential determined. The method is then applied to two practical examples, one a simple aerial with six single-wire ribs and the other a more complicated case in which each of the five ribs consists of a four-wire cage, the size of the wire being different from that used for the central vertical wire.

Tests on actual aerials have shown that the values of the capacity as calculated by the author's method agree with the measured values within the errors of observation and of estimation as to the allowance to be made for connecting wires, etc.

Committee on Gaseous Explosions.

Owing to the war, the completion of the equipment of the new laboratories of the Imperial College of Science and Technology has been seriously delayed, and the investigation of many problems of importance has had to be postponed. Also, many of the members have been engaged on work for the Government, so that researches on questions under consideration have been either prevented or interrupted. The committee, therefore, is not in a position to present a report to the Association this year. The general work of the Committee, however, has gone on; and during the session three meetings were held at the City and Guilds (Engineering) College.

Exposure Tests of Light Aluminium Alloys.

By Prof. Ernest Wilson.

(*Section G.—Abstract.*)

The physical properties of certain light aluminium alloys have formed the subject of reports during the last fourteen years. In order to investigate the influence of exposure to London's atmosphere, a specimen of each alloy has been placed on the roof of King's College, London. All the specimens are in the form of wire 0.126 in. (3.2 mm.) diameter.

Commercial Aluminium.—A specimen has steadily increased its electrical resistance by 17.2 per cent. in 13 years.

Copper.—It has already been pointed out that the electrical resistance of the copper series in a given time increases with the percentage of copper. One specimen containing 2.61 per cent. of copper had so far corroded in 1911 that it broke quite easily. Another specimen containing 1.86 per cent. of copper has now so far corroded as to become practically useless as an electrical conductor. The tests emphasise the opinion already expressed that alloying commercial aluminium with copper except in small quantity is not to be recommended.

Copper-Manganese.—Three alloys containing from 0.02 to 0.09 Cu and 0.05 to 1.78 Mn have steadily increased their electrical resistance by about 10 per cent. in 14 years. The specimen with the highest percentage has a breaking load of 35,000 lb., and is apparently in good condition.

Copper-Nickel.—A specimen containing 1.08 per cent. Cu and 1.29 per cent. Ni has somewhat diminished its electrical resistance—the percentage being now 12.4, as against 19.4 in 1908. Its breaking load was 45,900 lb. before exposure.

Copper-Zinc-Nickel.—One specimen containing 0.11 Cu, 1.77 Zn, 2.01 Ni, has varied its electrical resistance as shown by the following figures:—

Year	1901	1903	1904	1908	1911	1913	1915
	962	995	1013	1285	1125	1102	1102

Copper-Manganese-Magnesium.—The alloy known as "Duralumin" is stated to contain about 0.5 Mg, 3.5 to 5.5 Cu, 0.5 to 0.8 Mn. A breaking load as high as 90,000 lb. can be obtained according to treatment. The specimen exposed has steadily increased its resistance by 9.6 per cent. in four years. It is, however, so brittle that a small loop cannot be bent without fracture.

The author was unfortunately unable to report on the copper specimen, as it had been stolen from the roof.

The Cadmium-Vapour Arc-Lamp.

By Dr. H. J. S. Sand.

(*Section B.—Abstract.*)

The cadmium-vapour arc-lamp exhibited, the use of which was recommended for polarimetric and other purposes, is comparable in general principle with the well-known mercury-vapour lamp. The lamp is constructed of quartz-glass, and the cadmium is freed from oxide and dissolved gas by a process of filtration while at the pump. It is hindered from adhering to the glass by the presence of a small amount of a loose powder (zirconia) in the lamp. The metal is melted by external heating before starting, and maintains itself in the molten condition by the heat of the current. Once started the lamp may be kept burning for an indefinite time.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Portable X-Ray Apparatus.

The constantly extending employment of the X-rays has promoted a demand for portable sets of apparatus, and this has been met by the General Electric Co., Ltd., of 67, Queen Victoria Street, E.C., with their "Dubilier" outfits, of which one is illustrated in fig. 1. These are complete sets suitable for all classes of

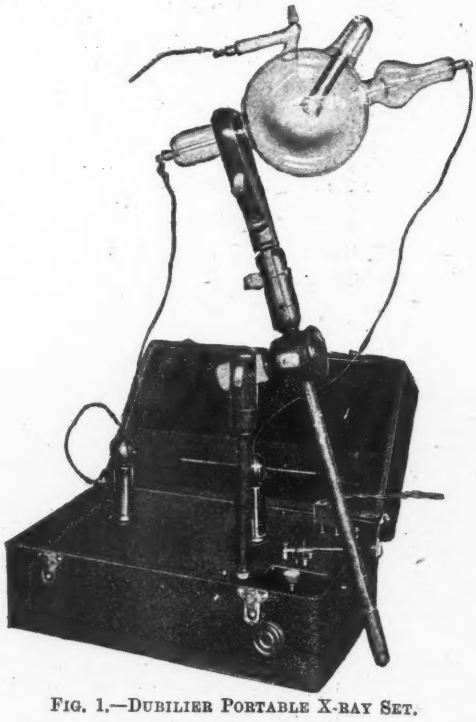


Fig. 1.—Dubilier Portable X-ray Set.

X-ray work, and operate on either D.C. or A.C. circuits between 55 and 250 volts, connection being made to a lampholder or wall socket, so that they can be used almost anywhere, and taken to the patient instead of the patient being taken to the apparatus. The current consumed is small, and the outfit is suitable for both fluoroscopy and radiography. Two patterns are made, one for general work, and the other, as illustrated, more particularly for dentistry, the latter also having an adjustable spark-gap for high-frequency treatment, and an attachment for cautery.

"Quead" Electric Fires.

In our issue of July 9th we illustrated the new type of heating element that has been introduced by Messrs. Ikin & Eads, Ltd., of 47-57, Marylebone Lane, Oxford Street, W.; we are now able to reproduce photographs of some of the various patterns of electric fires which they have developed, and in which these elements are used. The elements are standardised at one kilowatt each, and are

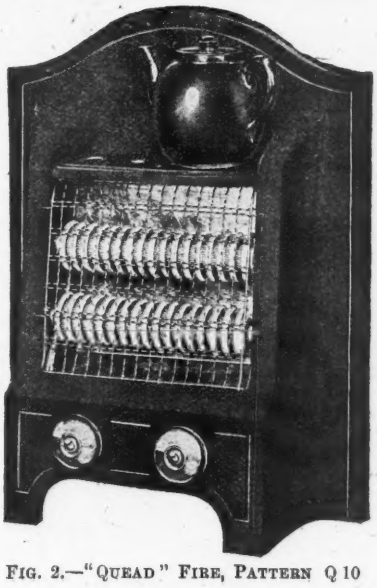


Fig. 2.—"Quead" Fire, Pattern Q 10

guaranteed for three years; they work at red heat, and therefore should satisfy those who are attached to the coal fire, while a further advantage which they share with the latter is the facility for keeping food warm on the top of the "fire." Fig. 2 shows a fixed pattern of fire, for a moderate-sized room, with a detachable

Fig. 3.—Portable Fire, Q 4.

shelf for utensils; each heating bar is controlled by a separate switch. Fig. 3 shows a portable model. Many other patterns are made to suit different requirements, from the "handy fire" for bathrooms, &c., taking one kilowatt, to the heavy pattern taking 4 kw. When there are three elements, as in fig. 3, two of them are controlled by two switches, and the third is controlled by the main switch, so that three degrees of heat are obtained.

LEGAL.

Munitions Court Cases.

At the Oldham Munitions Court last week, Messrs. Ferranti, Ltd., electrical engineers, of Hollinwood, complained under Sec. 4, Sub-Sec. 5, that Henry Tate, a transformer coil winder, had not worked diligently during the ordinary working hours, and had refused or neglected to obey the lawful orders of a person having authority over him. It appeared that he had been employed in the winding shop on transformer work, and his charge hand had to remove him to another part of the winding shop where he could be under the actual observation of the foreman. He behaved fairly well until September 14th, and then asked to be paid up. He was told to get on with his work and settle down to it. He did little work that day, and next morning he was in the works at seven o'clock, but did no work. Those over him reasoned with him and used every endeavour to get him to work, but failed. On September 14th, said Mr. Riley, foreman, Tate only wound nine coils, whereas he should have done 19 or so. On the following day Tate said he did not intend to work. Tate told the Court his ambition was to get on armature winding instead of the work he was put on. The Court held that Messrs. Ferranti had fully made out their case and fined Tate 10s.

At the same Munitions Court, last week, Richard Hollins, iron turner, employed in the Oldham Corporation tramway department, complained that his discharge certificate had been unreasonably withheld.

Mr. Dugdale, general manager of the tramways, said that if the man left the department they would have no one left to attend to the bearings of the cars. Mr. Dugdale had been in communication with the Ministry of Munitions, and the man Hollins had received a communication from the Ministry stating that the national interest could best be served by his remaining at present in the employment in which he was now engaged.

Hollins told the Court that he desired to leave to better himself financially.

The seriousness of the position, if Hollins left, was pointed out by Mr. Dugdale, who also pointed to the number of fitters and skilled men who had left the department for munitions work. Mr. Dugdale suggested that as his department was conveying workmen to and from work on munitions, it came under the clause "an establishment employed on, or in connection with, munitions work." The Chairman said that was much too wide.

Eventually Hollins was given a certificate to the effect that no discharge certificate was required by him, but the Chairman said that the Court would be very glad if he would go back to his work in the tramway department.

Broken Lamp Standard.

A question of dual responsibility was raised in an action heard by his Honour Sir W. Lucius Selfe, in the West London County Court, on Tuesday. The Fulham Borough Council claimed £19 1s. from Messrs. Wm. Whiteley, Ltd., and B. H. Winteringham, of Battersea. Counsel for the plaintiffs stated that at 8 p.m. on January 1st, 1915, one of the defendants' vans was proceeding along New King's Road, Chelsea, and collided with a motor-car belonging to the other defendant, and the two vehicles fell against an electric standard, which was knocked down, and damage done to the amount claimed. Both parties were written to as to paying the repairs. Whiteleys said the car-driver was at fault, and the car-driver cast the blame on Whiteleys. After evidence as to the facts, from which it appeared, that as Whiteley's driver was crossing the road, the car came up, and, "skidding," ran into the van, which toppled over, followed by the car, and felled the lamp and standard, his Honour found that Whiteleys were to blame, and gave judgment for the Council against them, with costs.

CORRESPONDENCE.

Letters received by us after 5 p.m. on Tuesday *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Pocket Dry Batteries.

I noticed in the last issue of your paper, of which I am a regular reader, "Howard Berry" comments on the remarks made by "Dry Battery Manufacturer" on the voltage of dry pocket batteries.

I may mention that, like "Howard Berry," I have for a good number of years experimented with the making of dry cells as a hobby, and can also obtain at will voltages from 1·2 to 2·2 with a single cell of overall dimensions 2½ in. high by ¾ in. diameter. But the point is this: he does not state how long they will remain in that condition when not in use, which is, I believe, the principal factor. I may also mention that I have at the present time pocket lamp batteries that have been in use since January 1st; of course they have been used only when necessary.

Robert Porrill.

London, N.E., *September 24th.*

Telegraph and Telephone Tariffs.

Although, generally speaking, the increase in taxes and rates causes no consternation, it is a matter for surprise that the technical Press has not in this instance pointed out that one way to make money is not to lose it.

The National Telephone Co. in 1911 paid the Government over £353,000 in royalties, and 6 per cent. on a greater part of its capital; soon after the system passes into the hands of the Government the surplus on the year's working is less than the amount

received in Royalties from the National Telephone Co., therefore the rates are to be increased.

Rather than sink this huge sum annually in inefficient methods, do you not think it reasonable to suggest that an independent board of business men, skilled in this kind of work, should be given control, or better still, resell the plant to the old management?

Economy with Efficiency.

[We pointed this out long ago, while there was still time to prevent the loss, and urged that, if the transfer must take place, a board of business men should be given the control of the undertaking. But it was of no avail; *quem Deus vult perdere, prius dementat*. Parliament will not listen to reason.—Eds. Elec. Rev.]

The A.E.G. Meeting.

I heartily concur with "Inquisition's" letter in your last issue. The Electrical Co. shorn of its British title is the A.E.G. Co., of Berlin. Yet to the disgrace and shame of the Tungsten Lamp Convention, the A.E.G. name is still retained on their lists, and this company in England is selling or, rather, offering the lamps manufactured by members of the Convention.

It is a matter for regret that there should still be Englishmen who associate themselves in the continuance of this concern.

Impatient.

September 21st, 1915.

The questions raised by "Inquisition" in the last issue of your paper, with regard to the Electrical Co., Ltd., should not be allowed to drop until they are definitely cleared up, at least as regards the names of the manufacturers supplying the goods, and any contractors who are drawing their supplies from this quarter.

After the war we shall have to meet the keenest possible competition from German electrical manufacturers, who will make their utmost endeavours to recapture trade, and any manufacturer supplying goods to this company, and thereby enabling it to maintain even the nucleus of a selling organisation, or to retain its connection, is doing a sorry service to the trade, and to himself also, because his business will be immediately cut off as soon as it has served its purpose and he is no longer needed.

I trust, Sir, that you will continue to move in this matter until the trade presents a united front on this question.

Unitas.

September 22nd, 1915.

Writing as a private individual, happily so placed as to be free from danger of financial hardship due to German competition, I have always regarded with complete astonishment the attitude of the electrical trade since the war towards the A.E.G. Co. When I read the speech of Dr. Rathenau's at the recent A.E.G. meeting, I came to the conclusion that his hearers must have been either drugged with despair or of German nationality. The electrical trade has furnished thousands of soldiers for the war, and some of the largest concerns are still struggling with staffs depleted of their best workmen at the commencement of the war. Some of us have to mourn colleagues as a result of this war, and yet, after 12 months, the director of a purely German company, English only by a legal device, is able to stand up and declare that his premises are still open, and that his business is in being. It is no good begging the question, for we know that the German stocks in England have been exhausted months ago, and my own opinion by comparison of the furtive-looking drawings which the Electrical Co. now furnish with their tenders, is that the machines they are selling are made and bought in England. I claim neither excessive sentiment nor patriotism, but the attitude of mind of an English firm who knowingly sell machines in order to keep the Electrical Co. in being after the war is incomprehensible.

At a music hall the other evening I noticed that quite the most popular song was one which shrieked in a minor key about our duty to keep the home fires burning till the boys come home, and undoubtedly this is a sentiment which is of tremendous importance in these dark times.

Without losing our self-proportion in any way whatever, it is our duty to our workers who are now fighting for us to stamp out once and for all the jumping-off places in England from which, after the war, the German concerns will start their campaign menacing the livelihood of the English soldier.

I have no use whatever for racial hatred as a religion, but I honestly believe that if one's sense of proportion is to go, the "Gott Strafe England" is less reprehensible than this nasty furtive money-getting.

I do not think any decent Englishman will materially disagree with the above attitude of mine, and if so, is there no way of definitely tracking down the people who are selling machines to the German companies? I do not know why the B.E.A.M.A. have not taken action before, as they, I hear, represent the bulk of the electrical trade.

I would gladly take a page of the Electrical Review which could be reserved for the names of firms who have not supplied for the last nine months any machinery whatever to certain firms named on this page. This should help a little, anyway.

No Furtiveness.

September 28th, 1915.

BUSINESS NOTES.

Consular Notes.—GREECE.—The American Consul at Athens reports that announcement has recently been made that the Government Commission charged with the study of the question has recommended the award to the Western Electric Co., of Chicago, of the contract for furnishing and installing a central station and switchboard at Saloniki and furnishing a central station at Athens with all equipment, including several thousand telephone instruments. The price to be paid by the Greek Government is understood to be in the neighbourhood of £40,000, and payments will be extended over a period of several years.

ADEN.—The American Consul at Aden reports that an electric railway between the various parts of Aden-Tawahi, Maala, Crater and Shaikh Othman—would undoubtedly pay well upon the comparatively small capital required for its installation. Not only would it carry passengers between these places, but also freight from Tawahi and Crater to the wharves at Maala. The same power plant could develop sufficient electricity to supply Aden with electric light and power for electric fans, which would tend to make life endurable in one of the hottest places on the globe.

PERU.—The American Consul at Callao reports that the company known there as the Empresos Electricas Azociadas (Lima Light, Power and Tramways Co.) holds practically a monopoly of the electric railway, power and light in Lima, Callao, and several of the suburban towns. The company's revenues from its various branches during 1914 amounted to $1,913,468, as compared with $1,981,560 in 1913, a reduction of $68,092. The gross expenditures were $1,328 223 in 1914 and $1,420 594 in 1913, representing an economy of $92,371. In view of the fact that these results were obtained during the most abnormal year in the history of the company, and the net receipts of the year under review were the largest yet obtained by the company, the year's results were highly satisfactory. The two principal factors that affected the revenues of the company were the disturbed political situation in the first half of 1914 and the consequences of the European war during the second half.

The light and electric power section shows for 1914 a decrease in gross receipts of $1,752. A considerable decrease in the revenues from the consumption of electrical energy in motive power is to be expected during the present year on account of the decreased operation or the complete stoppage of the principal consuming factories and the closing of other workshops and centres of industry during the latter part of 1914.

During 1914 the installation of the fourth hydroelectric unit in the Yanacoto generating station was completed, furnishing four units with a total capacity of 10,000 H.P. And the new contract for the public lighting of Lima, which has been under negotiation for a long time, was also ratified during the year. This contract is for a term of 10 years, and fixes the rate of service to be rendered at $4,866 a month, or $58,392 a year. The company is obliged to provide 660 lamps and 1,600 incandescents for the services of the city, and to effect all extensions which may be normally required by the municipality in the lighting service. Such installations are to be made without cost to the municipality and remain the property of the company.

The gross receipts of the urban and interurban tramways amounted during 1914 to about £200 000, a decrease of about £9.000 in comparison with 1913. The gross receipts of the Lima urban tramways were about £90,000, or about £3.800 less than the preceding year. This section was augmented during the year by 12 new American-built cars of the latest type. There was a reduction in the revenues of the Lima-Cherrillas tramway of about £2,350, the gross revenues of the year being about £56,000. The branch from Lima to Callao also suffered decreased revenues to the amount of about £35.000, in comparison with 1913. This is due to the suspension of maritime traffic and the limitation of business in Callao, an essentially maritime port, the traffic of which is dependent upon the volume of business and movement therein. The Magdalena Interurban Tramway is the only one that showed an increase in the gross receipts of the year, being about £7,000 in 1913 and about £7,500 in 1914. The number of passengers carried by the tramways of the company fell off from 29.020,888 in 1913, to 28.120,425 for 1914. A dividend of 1 per cent. was distributed during 1914 in accordance with the agreement entered into with the bondholders. The tenth annual report of the directors of the Sociedad Electrici de Arequipa, Ltd., shows that the lighting service in 1914 returned revenues to the amount of about £15,600, or about £770 greater than in 1913. The gain in the revenues from the power service during 1914 over 1913 was about £970.

SOUTH AFRICA.—The American Consul at Port Elizabeth reports that the opportunities for increasing American trade in the future should be fairly numerous. There is still, however, one most essential detail for American exporters to learn. South Africa, as a whole, is conservative, and many of its people are most pronounced in their ideas, and cling tenaciously to them. When the products required are more or less similar to lines already established, and in many instances superior, American salesmen are apt to make the mistake of attempting immediately to convince the prospective customer of the inferiority of the article he has been selling in comparison with the article he wishes him to sell. Experience has taught older salesmen in South Africa a better method. The product is discussed cautiously until the salesman is able to determine what chance, if any, there is of introducing his line. If considered favourable, the proposition is presented as soon as possible. If only trifling details of construction or finish are objected to, and the trade is of reasonable importance, the desired

changes are agreed to. If of considerable importance, the salesman procures samples and prices, and submits to his principals for decision as to whether or not they can be manufactured at prices quoted, or lower. In many staple products standards and patterns of long years' standing are still in use, with little evidence of desire to change. The Consul accordingly observes that if American manufacturers want the trade they must either make the goods asked for, or engage in a campaign of education in connection with their products.

CHINA.—The American Consul at Shanghai reports that the railless electric cars which were placed in the Shanghai Streets several months ago by the Shanghai Tramways Co., and subsequently withdrawn on account of the imperfect roadbed have now been restored, the roads having been rebuilt with concrete foundation and surface so as to be able to bear the weight of the cars. Five cars are being placed in service on one road. A number of improvements have been made in the cars since they were first placed in service. It is expected that this railless car system will be given a thorough test, and if it proves successful other routes will be established. Elsewhere the Consul reports that American railway and electrical supplies are being favourably received, and large purchases will necessarily have to be made in the near future, particularly for the necessary upkeep of the railways now in operation. The aggressive local managers of the United States Steel Corporation and other American enterprises are alert and capable of securing and holding available and desirable trade.

BRAZIL.—The American Consul at Bahia reports that work in a large hydro-electric plant was practically stopped throughout last year. The company constructing it is called the Companhia Brazileira de Energia Electrica (of which the chief owners are Messrs. Guinle & Co., of Rio de Janeiro). The plant is planned to generate 25,000 H.P. by using a natural fall in the River Paraguassu, near Bahia, but the company has been subjected to delays, and has asked for an extension of time for its franchise with which to complete sufficient of its plant to generate 5,000 H.P. It is hoped that this will be ready in 15 months.

Catalogues and Lists.—Messrs. Siebe, Gorman and Co., Ltd., Westminster Bridge Road, London, S.E.—Illustrated pamphlet describing their "Vivator" oxygen resuscitating apparatus, for use in cases of collapse from electric shock, gas-poisoning, apparent drowning, &c.

The Electrical Supplies Co., 53, Victoria Street, London, S.W.—Catalogue entitled "Concerning Electric Fires," containing illustrations, brief particulars and notes of prices of "Quead" and "Ensign" pattern electric fires.

Messrs. Dick, Kerr & Co., Ltd., Abchurch Yard, Cannon Street, London, E.C.—This is a well-produced art publication bound in a cover of neat design, in the 40 pages of which is given an interesting account of the company, the various works in which it conducts its manifold electrical manufacturing operations, and some of the important contracts (electrical, engineering, and general contracting) that have been carried out by it in all parts of the world. The publication is fully and excellently illustrated, the many half-tones including views of the electric manufacturing works at Preston, and their various departments, the Britannia Lamp Works, and the Britannia Engineering Works at Kilmarnock. Among the plant illustrated we observe turbo-alternator sets for the L. & S.W. Railway, the L.C.C., for Madras and for St. Helens, alternators for Japan and British Columbia, the power house at Kinlochleven, electric locomotives for British Columbia, H.T., D.C., electric railway work in Lancashire, Thury winding gear, steam locomotives, track construction in Mexico, electric tramway construction at Mandalay, Walton pumping station, the experimental tank of the National Physical Laboratory, electrically operated bascule bridge at Deptford Creek, ferro-concrete building work, and reservoir work of the Metropolitan Water Board. Many other views show electrical and other machinery, and from what we have said, it will be seen that the publication contains a representative account by pen and picture of the large and varied undertakings carried out by one of the best known of British electrical and engineering manufacturing and contracting firms. Editions of the work in Spanish and Portuguese are now in preparation. Not a large number of copies of the book are available for distribution, but the firm will be pleased to send a copy to any *bonâ fide* inquirer on receipt of application.

The British Thomson-Houston Co., Ltd., Rugby.—Illustrated price list giving particulars of motor control panels for C.C. circuits.

Messrs. A. Gallenkamp & Co., Ltd., 19/21, Sun Street, Finsbury Square, London, E.C.—Illustrated list No. 65 (8 pages) containing full particulars of their improved electric laboratory furnaces.

India-Rubber Gutta-Percha and Telegraph Works Co., Ltd., 106, Cannon Street, London, E.C.—Folder, giving particulars, prices, and test results, of Hercules dry cells.

British Thomson-Houston Co., Ltd., 77, Upper Thames Street, London, E.C.—A new illustrated price list of Mazda wire-drawn lamps. Voltage, wattage, candle-power, dimensions and price are all clearly tabulated. All the standard Mazda lamps are included, and Mazda "half-watts" have a couple of pages to themselves. A quite distinctive design in colour adorns the cover. In the charming flight of fancy the sun absolutely doesn't stand the ghost of a chance.

New Zealand Imports.—An Australian newspaper states that at a conference of New Zealand Chambers of Commerce early in August a resolution was passed in favour of legislation to make compulsory the marking of the name of the country of origin on all goods imported into New Zealand.

Bankruptcy Proceedings.—Alexander B. Gillespie, electrical engineer, 499, George Street, Aberdeen, was examined in sequestration, before Sheriff Laing. In reply to Mr. S. M. Chrystall (for the creditors) Gillespie explained that he had been in business since 1912 in the shop. Previous to that he had been in a small workshop. He had a partner for about a year. He first found himself in serious difficulties in 1914, but he had been in difficulties all along for want of capital. He had very little capital when he started, only a pound or two. He had taken things too cheaply, and had one or two bad debts. He had had some very big contracts. His liabilities were £218, and his assets £46, providing for a dividend of 3s. 6d. in the £. The Sheriff administered the usual oath.

T. A. Flather, electrical engineer, Leeds.—October 13th is the last day for the receipt of proofs for dividend by Mr. H. C. Bowling, 24, Bond Street, Leeds, the trustee.

Catalogues Wanted.—Messrs. Marsh Bros., who have removed to 41-43, Fargate, Sheffield, where they have fitted out a complete electrical showroom, invite manufacturers to send them copies of their latest lists of electrical accessories, heating and cooking appliances.

Trade Announcements.—We are informed that the Robertson Electric Lamps, Ltd., and Osram Lamp Works, Ltd., have been amalgamated, and the business will in future be carried on under the title of Osram-Robertson Lamp Works, Ltd. In connection with this almagamation the new company has purchased the entire interest in the Lemington Glass Works, Ltd, Lemington-on-Tyne, which company will continue under its own name as heretofore. The Osram-Robertson Lamp Works, Ltd., has taken over the obligations of all three companies.

Messrs. James Gordon & Co. removed on Tuesday last to larger offices at Canada House, Kingsway, London, W.C. Telephone No. "Holborn 1195."

In order to more efficiently cope with extending business, the Swedish General Electric, Ltd., have now opened up a branch office at Lloyd's Bank Buildings, Manchester, which will deal with all inquiries emanating from Manchester, Lancashire and Cheshire districts generally.

LIGHTING and POWER NOTES.

Aberdeen.—Price Increase.—The T.C. has rejected, by 20 votes to 10, the Electricity Committee's recommendation that the charges for electricity be increased by 15 per cent. all round, and decided that the charge for current for lighting (including public lighting) be increased by 10 per cent., and the charge for motive power (including heating and cooking) be increased by 25 per cent.

Abertillery.—Annual Report.—The report of the Council's electricity undertaking for the year ended March 31st last, shows that the income for the year amounted to £2,301, an increase of £253 on the previous year; the expenditure was £1,855 and the gross profit £445, an increase of £340; after deducting loan and other charges £1,751, there was a deficit of £1,306. The net deficit since the inception of the undertaking to March 31st is stated as £4,827; at that date £2,901 had been provided ont of the district rate, and a further £620 has since been transferred to rate account, leaving £1,306 to be provided for in future. The cost per unit sold had been reduced from 4·197d. to 3·649d., and the sale had increased by 10,970 units for the year under review.

Bootle.—Proposed Loan.—The T.C. has confirmed a proposal of the Electricity Committee to acquire for the electricity works two boilers in course of construction by Messrs. Babcock and Wilcox, Ltd. Application is to be made for sanction to borrow £8,000, £5,500 being for the boilers and £2,500 to cover cost of erection, &c.

Bristol.—Price Increase.—The T.C. has increased the price of current for lighting by 7½ per cent., and for all other and combined supplies by 15 per cent., from the date of recording the meters for the September quarter.

Bury (Lancashire).—Overhead Cables.—The B. of T. has sanctioned the placing of overhead cables from Barnbrook, Bury, for the transmission of electric current in bulk to the Heywood Corporation. As far as possible the tramway standards along Bell Lane and Rochdale Old Road will be used.

Buxton.—The contractors for the electric light at St. Mary's new church have asked the U.D.C. for terms for electricity. The Council has replied regretting that it cannot advise the placing of a distributor for the supply along Dale Road, and suggesting that a cable be laid, if required, subject to the net cost being charged to the Church Building Committee.

Castlewellan. — Prov. Order. — The L.G.B. has informed Downpatrick Council, that as a result of the inquiry recently held into the application of the Council to be vested with powers of an urban authority in order to light the town of Castlewellan by electricity, such power has been granted. The Board has also approved of the E.L. scheme and the number of lamps to be erected.

Carrickmacross.—A limited company has been formed, with a capital of £6,000, to purchase the business of the manufacture and sale of gas and electricity now carried on—the former by the Carrickmacross Gas Co., and the latter by Messrs. John McKeever and J. J. McCaul, of that town. The electrical plant is capable of dealing with 200 average installations; 25 per cent. of this number have already been connected, and orders are coming in regularly. The new company takes over important contracts for electric supply to the Great Northern Railway Co., of Ireland, and the Carrickmacross U.D.C.

Charleville (Co. Cork).—The public electric lighting scheme, which cost about £2,500, has now a revenue of about £600.

Chesham.—By arrangement with the E.L. Co., the U.D.C. has decided to discontinue street lighting.

Colchester.—Year's Working.—The accounts of the electricity supply undertaking for the year ended March 31st last show an increase in the output, 1,658,596 units having been sold, as compared with 1,623,526 during the preceding year. The total income was £18,110, an increase of £301. The works cost was £10,297, an increase of £159, and gross profit £7,813; after deducting £5,914 for interest and redemption charges, and writing off £1,086 for prepayment installations, there was a net profit of £813. The load factor was 20·49 per cent., maximum load 924 kw., and the generating plant capacity 2,030 kw. The total costs per unit were 1·49d., and the average price obtained from private supply was 2·99d. per unit, public lamps 2·23d., and tramways 1½d.

Continental.—Russia.—In a study of the resources of the Caucasus in connection with the Russian mobilisation of industry, it is observed that the hydro-electric installations in the towns of Hagri, Suchum, Novykaphon, Batoum, Artvin, and Borzhom have outputs of 540 to 1,500 h.p. They are being turned to account at the moment for the usual local requirements; but a portion of their power, it is claimed, should be used for the production of chemicals. In the matter of equipping electric furnaces in the Caucasus for the production of nitrates, the Commission has entered into negotiations with suitable firms.

It is stated in the Caucasian Press, that the question of using the water power on the Rivers Kuban and Maloi-Latu is being considered. The Council of the Caucasian Viceroy has approved the chief points of an agreement (with some change of details) with Y. Nikolenku, for a period of 75 years, allotting him land on the said rivers; but with the right of the Government to buy him out after 30 years. The estimated power of the station is 45,000 kw., and exceeds that of all the other electricity works of the Caucasus put together, which aggregate 30,600 kw., not counting the plant connected with the mining industries. It also exceeds the power of the Larsk station included in the Stewart concession. The Nikolenku concern will require a capital of 15,000,000 roubles.

Spain.—A small electricity generating station has just been completed and put in operation at Ciudad Rodrigo, by the Sociedad Hidroelectrica del Agueda. Certain available water-power near the town is being utilised.

Doncaster.—Annual Accounts.—The abstract of accounts for the year ended March 31st, of the electricity department, shows receipts amounting to £15,789, as compared with £14,344 during 1913-14; the expenditure was £14,494, as against £13,329 during the preceding year, and there was a surplus of £1,295, as against £1,015 in 1913-14. Under existing powers the Corporation can still borrow £874 for the electricity department, whilst the undertaking still owes a balance of £69,860 of the sums which have been borrowed for expenditure on the works.

East Ham.—Annual Accounts.—The total income of the electricity undertaking for the year ended March 31st last was £29,859, as compared with £32,737 for the previous year, a decrease of £2,878. The expenditure was £18,599, a decrease of £1,624 as compared with 1913-14. The gross profit was £11,260, against £12,514, a decrease of £1,254, represented by £2,878 deficiency in income, less £1,624 decrease in expenditure. After meeting all charges, including revenue contributions to capital expenditure, there remains a deficit at the close of the year of £365. The Electric Lighting Committee recommends that the deficiency be charged to the depreciation and renewals fund. Having regard to the decreased consumption of current for public lighting and business premises in consequence with the restricted lighting order, together with the extra cost of generation, the Committee recommends the Council to increase the charges for all current supplied, by 20 per cent., from and including the December quarter.

Fleetwood.—Price Increase.—The Electricity Committee has recommended that from the end of September the price of current should be increased 10 per cent., the increase not to apply to electricity consumed through prepayment meters.

The question of the conversion of the existing gas lamps in the town to electric lamps has been deferred.

Gravesend.—The T.C. has adopted the recommendation of the Electricity Committee to erect a concrete retaining wall at the works for increasing the capacity of the coal store, at a cost of about £250.

Grimsby.—Price Increase.—The E.L. Committee has increased the charges for current as under:—Lighting, from 3¾d. to 4d. per unit; maximum demand, from 1d. to 1½d.; power, first 450 units, from 2¼d. to 2½d., with no charge beyond; time switch, first 50 units, from 8s. to 9s. The increases will add £1,000 per annum to the revenue.

Hastings.—Price Increase.—The T.C. announces that as from the reading of the meters for the current quarter, the charges for current supplied to private consumers will be temporarily increased by 10 per cent. This is due to the increased cost of fuel and materials, and to other existing exceptional circumstances.

Hawick.—Valuation Appeal.—At the Annual Valuation Appeal Court, the Urban Electric Supply Co., Ltd., appealed against the assessors' valuation of their works at £2,420, and proposed that it should be returned at £1,180, the amount last year having been £1,700. The Court fixed the valuation at £2,300. It was stated that there would be an appeal to the Court of Session.

Holyhead.—The U.D.C. has decided to give the London and North-Western Railway Co. a supply of current for lighting and power at Holyhead station, at 3d. per unit. The annual consumption will be about 94,000 units for lighting, and 1,300 units for power.

Kilmallock (Co. Limerick). — E.L. Scheme.—A public meeting has appointed a Committee to take steps for an improved public electric light service. Messrs. J. J. Murphy & Co., who furnish the present service, intimated that they would maintain it until April next, and that they were prepared to take shares in the new scheme.

London. — Stepney. — Year's Working. — The accounts of the Corporation electricity undertaking for the year ended March 31st last show a total income of £93,637, being an increase of £7,197 over the previous year; the total expenditure amounted to £48,568, an increase on 1914 of £6,514; this leaves a surplus to be carried to net revenue account of £45,070, as compared with £44,387, representing a gross profit of approximately 8¼ per cent. on the average capital employed. There has been an increase in the number of units sold, from 16,197,123 to 18,757,007, made up as follows:—Private consumers for lighting, 4,668,062 units; for power and heating, 7,751,032 units; in bulk for lighting, power and heating, 4,112,801 units; public bulk supply, 1,562,707 units; and public street lighting, 662,405 units. The total net revenue account, including the amount brought forward, amounted to £45,611; after deducting £31,442 for loan charges, £1,200 for stand-by and other charges amounting to £2,267, the net profit carried to the appropriation account was £10,702, as compared with £14,177 in the previous year. The net profit of £10,702, with £1,448 brought forward, amounts to £12,150, which it is proposed to deal with as follows:—£525 income-tax on profits; £6,165 capital expenditure; £502 to be written off capital account in respect of assets (machinery, mains and meters) now non-existent, less £13 on house services; £1,837 in respect of items of a special nature; and £2,000 to reserve, carrying forward £1,134. The general reserve account now stands at £28,000. The total average cost per unit sold was 1·024d., the lowest but one on the record of the undertaking.

Hackney. — Price Increase. — The Electricity Committee reports that, after consideration of the borough electrical engineer's report upon the position of the electricity undertaking as affected by the conditions now prevailing, it is anticipated that a considerable loss on the year's working will occur instead of a surplus of £30, as anticipated when the estimates were under consideration; under the circumstances, in order to meet the deficit, the Committee recommends that, as from the date of the readings of the meters for the quarter ending December, 1915, the existing scale of charges for electricity be increased by 10 per cent.

Hammersmith.—The Electricity Committee recommends that a supply of electricity be given to the works of Regal Films, Ltd., who are prepared to guarantee a minimum payment of £100 per annum for a period of five years.

The electrical engineer reports that, owing to the increased demand for electrical energy for factories engaged on Government work, it will be necessary to obtain seven additional 200-kw. transformers.

The L.C.C. has made arrangements for the B.C.'s application for a loan for the proportion of the cost of the Battersea, Fulham and Hammersmith linking-up scheme, to be reconsidered at its first meeting after the recess.

Poplar.—The electrical engineer reports a substantial increase in the output of the undertaking for the June quarter of 1,076,456 units, or 31 per cent. The total income was increased by £3,297, while the coal bill was only increased by £1,858. The net profit, when ascertained, will show an increase over the corresponding quarter of last year, due, in the opinion of the Electricity Committee, entirely to the favourable purchase of coal in November last for future delivery.

Bethnal Green.—Mr. H. W. Couzens, the Council's consulting electrical engineer, has reported that in the area of the new Tyssen Street sub-station there are sundry premises which are likely to become users of electricity if a supply is available, and he suggests that it would be in the interests of the Council, when the road is opened, that a distributor cable should also be laid in order to afford a supply to that district. The suggestion has been approved.

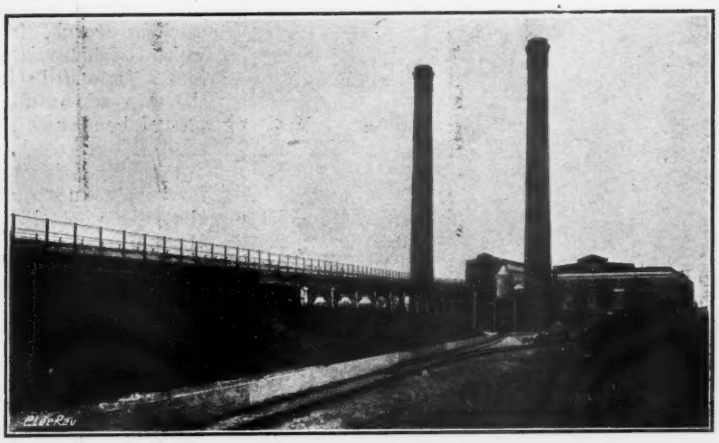
Stoke Newington.—The electricity accounts show a balance of £3,810; £3,000 has been carried to reserve, £500 to the credit of rates account, and the balance carried forward.

(*Continued on page* 435.)

LONDON AND SOUTH-WESTERN RAILWAY ELECTRIFICATION.

(*Continued from page* 391.)

We illustrate herewith the ferro-concrete viaduct built by Messrs. Holloway Bros., Ltd., which serves the purpose of a coal conveyor, and the store of coal outside the boiler-house; this coal can be conveniently shovelled into trucks on the adjoining siding, hauled up to the railway, and then carried along the viaduct into the bunkers over the boiler-house firing floor. These bunkers are of reinforced concrete, and have a capacity of about 1,400 tons. They deliver the coal through chutes to the hoppers of the mechanical stokers in the usual way.



Exterior of L. and S.W. Ry. Power House, showing Coal Viaduct and Outdoor Coal Store.

The boilers, of which 16 are at present installed, are of Messrs. Babcock & Wilcox's make, and are arranged in two rows running parallel with the turbine room, as shown in the adjoining view; the stokers are of the chain-grate type, operated by sprocket wheels and chains from a shaft running the whole length of each range of boilers, and driven by a motor, as shown on the left of the view. Two handsome brick chimneys, constructed on the Alphons Custodis principle, have been erected outside the boiler house at the permanent end of the building; each chimney is 230 ft. high, and has an internal diameter of 13 ft. 6 in. at the top. Green economisers are used to heat the feed-water, and the boilers are provided with internal superheaters, the output of each unit being normally over 20,000 lb. of steam per hour at a pressure of 200 lb. per sq. in., and with a superheat of 200° F.

The feed-water make-up, which is derived from the town mains, is softened and purified in an installation of water treating and filtering apparatus in the boiler house, and is stored in a covered reservoir having a capacity of 110,000 gallons, which runs the whole length of the building on the flat roof over the switchgear bay, and is divided into two compartments.

The ash-handling apparatus is situated at the end of the boiler house, and comprises a motor-driven blower connected with a receiver outside the building (shown in our view of the coal store); pipes running under each range of boilers in the basement open into this receiver, and are provided with openings under each boiler, which are normally closed by cast-iron plugs (see illustrations, p. 432). The ashes are dropped from chutes into a truck which is equipped with a motor-driven clinker-breaker, and after being reduced to a manageable size are fed into the pipe, the powerful in-draught ensuring that no dust or fumes shall escape into the surrounding atmosphere. The ashes are swept along into the receiver, where they are separated from the air-current, and are finally dropped into trucks on the siding below. Additional pipes are carried under the back sections of the boilers, to enable soot, &c., to be removed from below the tubes in the same way. The process is very rapid, cleanly, and economical.

Two of the feed pumps and a sump pump in the boiler house are driven by steam; with these exceptions, all the pumps and auxiliary machinery throughout the power house are motor-driven.

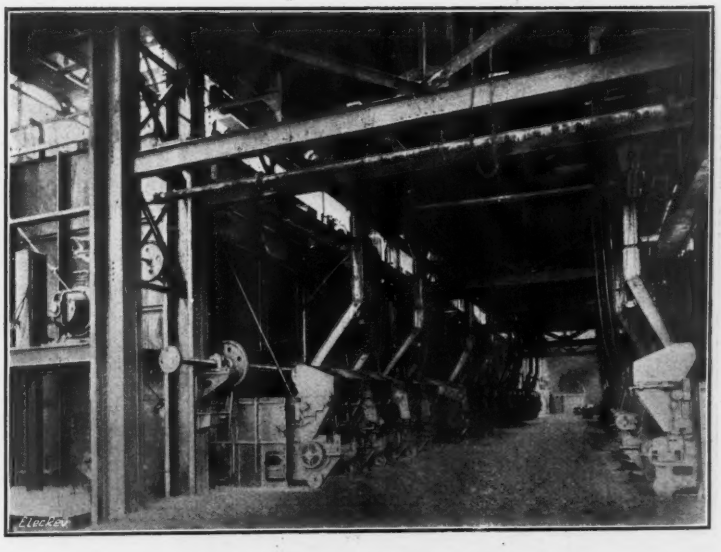
Amongst these machines are an air-compressor, and a vacuum pump for cleaning purposes. Two exhaust-steam feed-water heaters are provided.

The steam pipes are arranged on the unit system, a group of four boilers supplying each main turbine; the boilers and turbines can, however, also be connected to a common main, in order to give greater flexibility of working.

The main generating sets, which were supplied by Messrs. Dick, Kerr & Co., Ltd., are rated at 5,000 kw. each at 11,000 volts, 25 cycles per second, three-phase, when running at 1,500 r.p.m.

The turbines are of the impulse type, exhausting into condensers situated beneath them in the basement. Each generating set is provided with a direct-connected exciter, and a motor-driven fan for ventilating the alternator, the air being drawn through dry filters from outside the station.

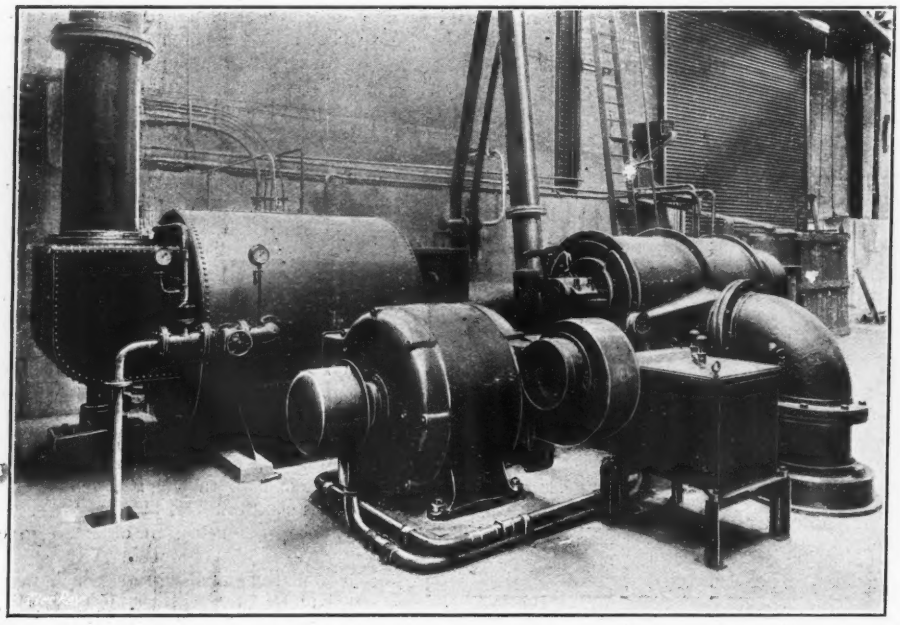
One of our views (p. 433) shows the generating sets, and incidentally the interior of the turbine room, together with the travelling crane, which was made by the Chatteris Engineering Works Co., and is of the three-motor type, with a lift of 40 tons. Another view shows the direct-current plant, consisting of three turbo-generators, made by Messrs. Dick, Kerr & Co., Ltd.; these are driven by turbines made by Messrs. Parsons and Co. through gearing, the turbines running at 5,000 r.p.m. and the dynamos at 575 r.p.m. These sets



Interior of Boiler House.

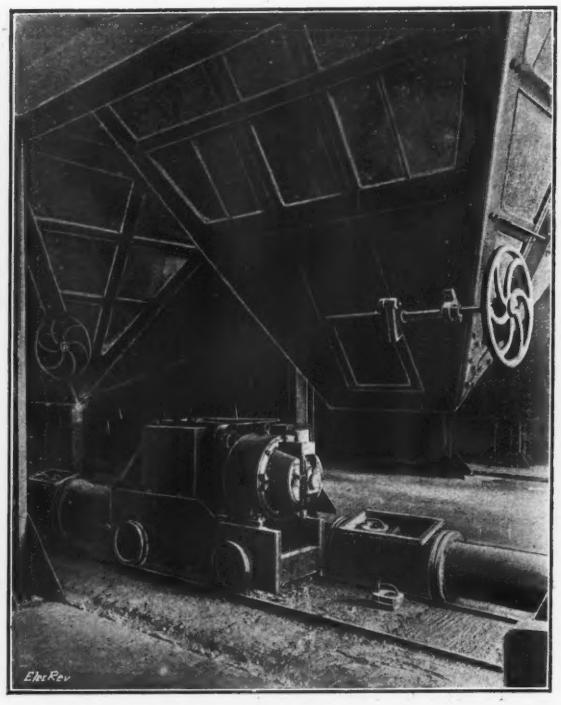
have each an output of 400 KW. at 220 volts, and supply energy for lighting and auxiliary power purposes, in conjunction with a Tudor battery as a stand-by.

The condensing plant was made by Messrs. Willans and Robinson, Ltd., and is provided with their rotary air-pump system, which is shown in one of our views. In this system



B. & W. Pneumatic Ash-handling Plant.

the air is extracted from the condenser by means of an ejector, the condensed steam being removed by a separate centrifugal pump from the bottom of the condenser. The pumps are driven by a small steam turbine, seen in the



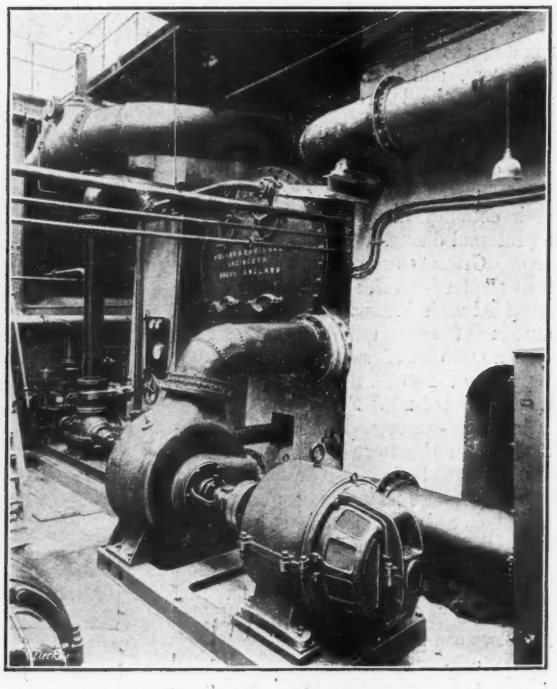
Ash Chutes, Clinker-Breaker and Pipes.

background of the illustration, while the circulating water pump is driven by a motor.

The system of dealing with the circulating water presents some novel features. As already mentioned, the circulating water is derived from the River Wandle, through open ferro-concrete ducts; the supply duct is laid with a fall towards the power house, and is provided at the inlet with a screen consisting of fixed bars, which are cleaned by means of a motor-driven rake, and are designed to deal with 2,000,000 gallons of water per hour. Close to the power house the water enters a chamber in which is mounted a rotary screen, in the form of a perforated disk, which is kept in rotation by a motor. A series of water jets directed against the upper portion of the disk, at the back, blows out any matter that may have collected in the perforations, driving it into a catching trough, from which the sludge is led into a perforated skip; the skip, when full, is hoisted by a crane and emptied into a truck.

From the fine screen the supply duct passes along the whole length of the engine room, alongside of the condensing plant in the basement. The discharge from the condensers is delivered into a similar duct, which conveys it back to the river over a series of cascades, by which it will be cooled to within a few degrees of the inlet temperature before it is finally discharged into the river. (This part of the plant is not as yet completed.)

Three large cooling towers, built by the Klein Engineering Co., Ltd., have been erected alongside of the water ducts at the river end of the power house, and the arrangement is such that at times when the supply of water from



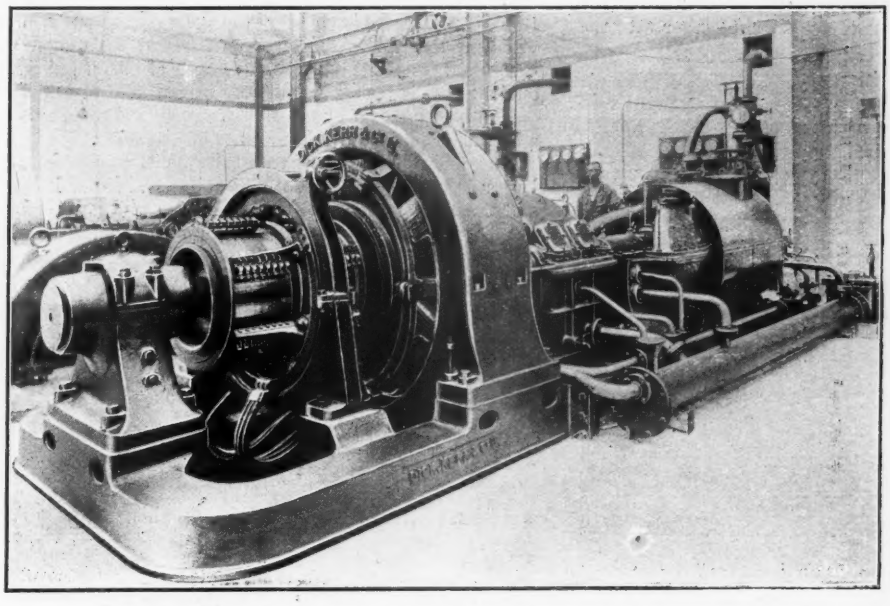
Willans Condensing Plant.

the river is inadequate, the discharge water can be pumped over the towers and delivered, after cooling, to the inlet duct. The ducts are built of reinforced concrete with a brick lining, waterproof sheeting being inserted between the lining and the concrete to prevent seepage.

(To be continued.)

THE SUPPLY OF ELECTRICITY AT STOWMARKET.

The Suffolk Electricity Supply Co. has recently completed an entirely new generating station at Stowmarket, which will practically supersede the old plant.

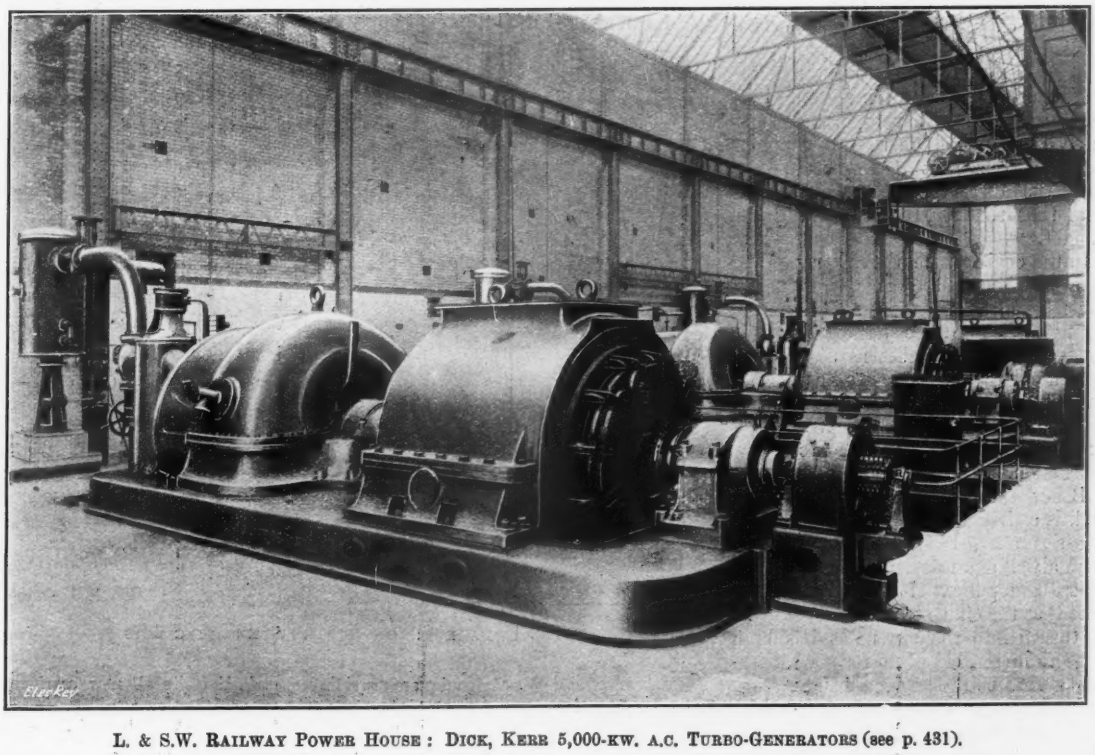


L. & S.W. Railway Power House : Dick, Kerr-Parsons D.C. Turbo-Generators.

Two four-cylinder vertical gas engines supplied by Messrs. Fielding & Platt, of Gloucester, have been installed, together with two multipolar dynamos made by Messrs. Mather & Platt and the General Electric Co., Ltd., respectively. One of these sets is entirely new, but the other has been doing duty in the company's Felixstowe station for some years. The new set has cylinders 1 in. larger in diameter than the old one, and develops 180 B.H.P. as against 150 B.H.P. for the smaller size ; otherwise the engines are substantially alike. The makers have, however, introduced a special ignition shaft across the tops of the cylinders in the new engine, with a handwheel for altering the timing. The ignition circuits derive their current from the main supply, and there are two lamps in series with the circuit for each cylinder, consequently the drivers have an ocular demonstration when any failure occurs. Both sets run at about 250 R.P.M. A rather unusual feature, devised by Mr. Napier Prentice, the engineer to the company, is the plan of drawing the air for the engines through the closed crank cases, whereby the moving parts are cooled while oil leakage is prevented owing to the slight vacuum induced. Naturally, oil separators have to be provided between the crank case and the engine cylinders, otherwise a good deal of oil would be drawn off with the air. This arrangement also prevents any leakage of gas into the engine room, which may have got past the piston rings.

Starting is effected by compressed air at 300 lb. pressure, which is stored in two vertical steel cylinders alongside of the engines. These air reservoirs are cross connected to either engine, while the motor-driven compressor is in duplicate, hence any failure of the air pressure is highly improbable.

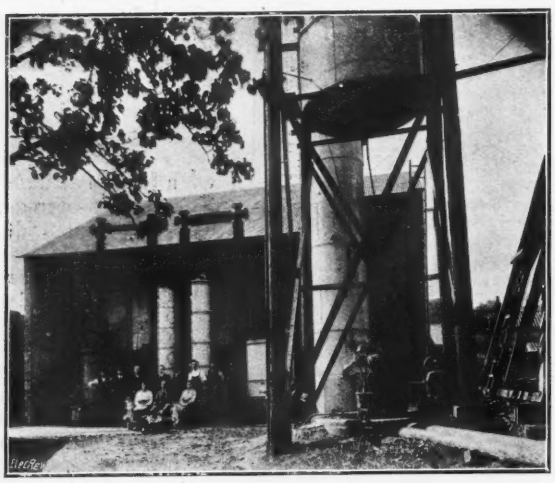
The water from the cylinder jackets is pumped over a wooden cooling tower of the "Klein" type, with the usual cooled-water tank below it. Two motor-driven centrifugal pumps are used for circulating the water, one of which draws from a hot well and pumps the water over the tower,



L. & S.W. Railway Power House : Dick, Kerr 5,000-kw. A.C. Turbo-Generators (see p. 431).

while the other forces the cooled water through the engines, whence it returns to the hot well by gravitation. There is of course some loss by evaporation, and this is made up from the town mains. The cooling system is completed by a circular galvanised steel tank mounted on a wooden framing, and having a capacity of 1,000 gallons. This tank, which is always kept full, forms an emergency supply in case the pumps fail.

Outside the generating station, and only protected by side walls and a roof, are two producers, together with the



Stowmarket Electricity Works: Producer House.

usual wet and dry scrubbers, a special feature of the plant being the cooling of the gas in a considerable length of gilled piping between the producers and the scrubbers. The fuel used is coke, which is hauled up to the feeding platform in a wheeled truck arranged for tipping when slung. When starting, the fires are drawn up by a motor-driven fan, which sucks from the piping at each engine, thus saving several idle revolutions for exhausting the air in the pipes.

Great care is taken to prevent gas getting into the engine room, and there is no communication with the producers except by going outside the building.

Another feature is the utilisation of the exhausts to provide ventilation. For this purpose the exhaust pipes are surrounded by an old boiler shell set up on end, and the heat from the pipes, with the discharge of the exhaust gases near the top, causes a strong updraught.

In the engine room the exhaust pipes from each engine are enclosed by metal screens open at the top, and communicating with the pipe trenches at the bottom. These trenches naturally open into the bottom of the boiler shell, hence air is being continually drawn in from the engine room, and carries off the heat from the exhaust pipes while promoting ventilation.

Below the emergency cooling-water tank is a similar tank, which supplies the wet scrubbers, the water being drawn from a well and raised by a motor-driven centrifugal pump. It is interesting to note that the effluent from the scrubbers is turned into the sewers, as has been done from the old plant for years, without giving rise to any complaints.

Hitherto the pressure of supply has been 100 volts, but with the new station this voltage is being doubled, and the dynamos are shunt-wound to suit.

The old battery, which was supplied by the D.P. Battery Co., has been increased to suit the new voltage, and now consists of 110 cells. Charging and discharging is carried out through a Crompton hand-regulated booster, but regulating cells and switches are also provided, to avoid running machinery at night.

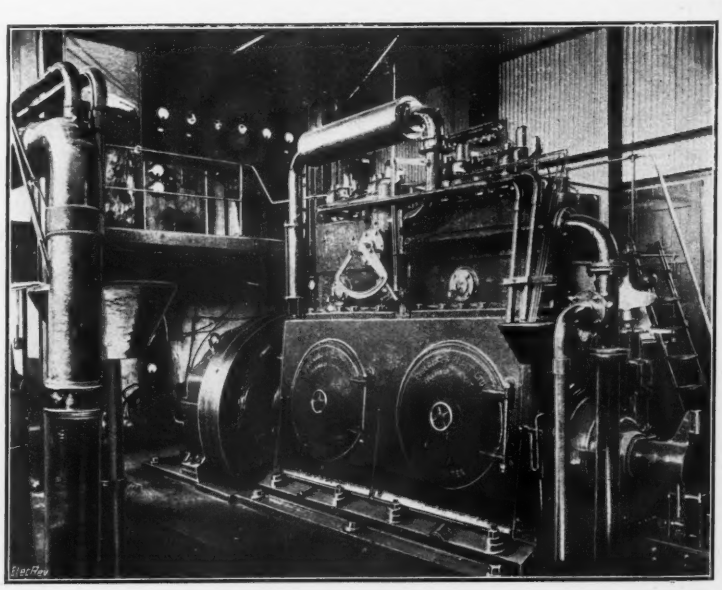
In one corner of the engine room, on a raised steel and concrete platform, is the switchboard, consisting of enamelled slate panels, with the usual fittings, and having very ample space at the back.

The engine room, forming the main building, is framed in steel, and filled in with brickwork, except the wall at one end, which is of corrugated iron, to allow of easy extension. Runways are provided over the generating plant, upon which is mounted a 5-ton crane. Terralite cement has been used for the floors, with footways of chequered bricks, and the roof is of corrugated iron carried on steel principals.

The battery room by the side of the engine room also has a corrugated iron end wall to allow of extension.

Excepting for the engines, dynamos, auxiliaries, and battery, this plant has been designed by Mr. Napier Prentice, and much of it has been made locally, while the erection has been carried out by the company's own staff. Even the cooling tower was made by local carpenters, although the design of the inside was supplied by the Klein Engineering Co., and all the motors were made by the East Anglian Engineering Co. at Stowmarket.

The work is being paid for largely out of revenue, hence economy has been closely studied, the scrubbers, for example, being made from the flues which came out of the boiler shell that surrounds the exhaust pipes.



Stowmarket: One of the Generating Sets.

Gretna Railway Disaster.—In his report to the Board of Trade on the Gretna troop train disaster of May 22nd, which involved 227 deaths and 246 cases of injury, Lieut.-Colonel Druitt repeats recommendations previously made for preventing the terrible results arising from the outbreak of fire among the wreckage after a bad collision. These include the provision of electric lighting in all new stock, gas lighting in existing stock to be abolished and electric lighting to be provided as opportunity admits.

After describing the scene following the collision the inspector says: "Fire under such conditions was inevitable, and I consider that the cause of the outbreak in the main part of the wreckage was due to live coals from the overturned engine of the troop train, and this was afterwards intensified by the escape of gas from the cylinders as they burst. But I consider that the fire would have occurred even if all the vehicles had been fitted for electric lighting."

Lieut.-Colonel Druitt understands that most of the principal companies are providing electric light in all new carriage stock, and some are arranging to convert existing gas-lit stock as opportunity occurs, but this must necessarily be a slow process spread over many years.

In the inspector's opinion, the responsibility for the collision lies entirely with the two signalmen, J. Tinsley and G. Meakin, who were sentenced at Edinburgh recently to three years' penal servitude and eighteen months' imprisonment respectively. The report mentions various rules, the infringement or neglect of which contributed to bring about the disaster.—*Daily Telegraph.*

LIGHTING AND POWER NOTES.

(*Continued from page* 430.)

Kirkheaton.—Proposed E.L. Scheme.—The members of the Council at their last meeting had a lengthy discussion in regard to the proposed applications of the Huddersfield Corporation and the Electrical Distribution of Yorkshire, Ltd., for provisional orders authorising them to supply electricity in the district of Kirkheaton, and eventually it was decided that the Council should give its support to the latter body.

Loughborough.—Price Increase.—Owing to the large increase in the cost of coal and wages, the T.C. has decided to add 12½ per cent. to all accounts for current, and to allow a discount of 5 per cent. for prompt payment of accounts.

Luton.—The electrical engineer is of opinion that as the H.T. mains to the sub-stations would probably have to be duplicated in five or six years' time, it would be ultimately more economical to lay the cable in ducts (instead of in wooden troughs), at an extra cost of £670. The Council has been recommended to comply with the engineer's suggestion.

Newcastle-on-Tyne.—Electric Cooking.—The Newcastle-on-Tyne Electric Supply Co. and its associated companies have reduced the price of current for heating and cooking purposes; the companies are also hiring out suitable electric heating and cooking apparatus.

Perth.—The Electricity Committee proposes to fix the charges for electricity for the coming year at the same rate as last year, and the T.C. is recommended accordingly.

Salford.—In the course of his just-published annual report, Mr. J. A. Robertson, borough electrical engineer, states that in January last he made certain recommendations as to the future development of electricity supply in the borough. In view of the restrictions placed by the Government on capital expenditure by local authorities during the war, and the difficulty and additional expense involved in carrying out new works at the present time, he was of opinion that the proper course was to utilise the existing works to their fullest possible capacity, even at a sacrifice in economy, leaving the question of a new station over until conditions are again normal.

Sheffield.—New Plant.—The Finance Committee of the Council is considering the question of important extensions of the electric supply department. It was reported that owing to the demand for power it was necessary that additional machinery should be purchased for the department, and that the Government was assisting the department to get the same. The estimated cost of the machinery and work was £100,000. The chairman of the Electric Supply Committee attended and asked the Finance Committee to approve of the machinery being purchased at any time if it was found desirable for this work to be done.

Southend-on-Sea.—Price Increase.—There was a discussion at last week's meeting of the Corporation on the Electricity Committee's proposal to increase the rate charged for current supplied through prepayment meters (reported in our last issue). Councillor Mitchell protested against this imposition made solely on the recommendation of the electrical engineer. Last year, he said, the Council made £12,000 profit on the undertaking by excessive charges in all its departments. On behalf of the Committee, Ald. Martin, said it had had a lot of trouble with the prepayment meters, and though the Council had been charging 5d. the amount derivable as income was less than 3d. The charges for the prepayment meters were such a worry that they had to increase the price to bring them to a paying level. The report was adopted.

Watford.—Loan Sanction.—The U.D.C. has received sanction to a loan of £1,850, part of amounts overdrawn on two sanctions of £2,585, and as regards the balance of £735, details are asked for. The L.G.B. has informed the Council that it is not prepared to sanction money for the laying of further mains, or for other purposes for the undertaking, except for purposes of the war. The Council has applied for a loan of £1,560 for mains enlargements, &c., caused by increased demands.

Wetherby.—E.L. Proposals.—The clerk to the Board of Guardians and R.D.C. has been instructed to communicate with three firms of electrical engineers, asking if they were prepared to report upon the advisability of applying for a provisional order empowering the Council to supply electricity for lighting purposes in the district.

Whitby.—Year's Working.—In connection with the electricity undertaking the following figures are included in the annual accounts for the year ended March 31st last. Receipts, £4,749; expenditure, £4,877; deficit, £128, which has been carried to the district fund. The amount borrowed in connection with the undertaking amounts to £36,286, of which £22,150 is outstanding.

Wigan.—L.G.B. Inquiry.—A L.G.B. inquiry was held last week into the application for sanction to borrow £6,700 for electrical undertaking. The money is required for two Stirling boilers, £4,620; mechanical stokers and fan, £1,152; pipe work, £508, and foundations, £225. The request was made that the matter might be treated as urgent, as the firms who desired more power were engaged on Government work.

Windsor.—Electric Pumping.—The new pumping plant installed at the waterworks consists of two Rees-Roturbo four-stage centrifugal pumps, operated by two electric motors of 135 B.H.P., the normal capacity being 60,000 gallons per hour, against a head of 226 ft., but this can be increased, should occasion arise, to 87,000 gallons, against the same pressure. Current is supplied from a trunk main coupling the Slough and Windsor generating stations, so that a supply is available from either works. A ten years' agreement has been entered into between the Corporation and the electrical company, whereby the Corporation agrees to pay a minimum sum of £150 per year, which includes the lighting of the buildings, and entitles the Corporation to 400 hours' pumping at the full rate before being liable for any extra charge for the power supplied.

TRAMWAY and RAILWAY NOTES.

Australia.—In the report of the Chief Commissioner of the New South Wales Government Railways and Tramways for the year ended June 30th, 1915, it is stated, under the heading of "Tramways," that the total electric current output for the year was 93,554,559 KW.-hours, of which the alternating current gave 92,500,524 and the direct current 1,054,035 KW.-hours. On comparison with the previous year, the total output shows a decrease of 3,515,762 KW.-hours, or 3·62 per cent. The new power house at White Bay is practically completed, and the two turbo-alternators "are now ready for operation as soon as the necessary switchgear is installed." It is added that in connection with the electric lighting of suburban railway stations, 5½ miles of H.T. transmission cable have been erected between Petersham and Flemington, and 2½ miles of H.T. concentric cable laid underground between Sydney Yard and Petersham Railway Station.

The Sydney tramways show a profit for the year ended June 30th last of £90,135, due to the increase in the fares which came into force in April, 1914. During the year eight miles of new tramways were constructed, making a total number of miles open 219¾.—*Sydney Daily Telegraph.*

Blackpool.—Tramway Traffics.—During the 28 days ending September 16th the tramway receipts were £14,763, or £5,186 more than during the corresponding period of last year. During the corresponding four weeks of 1913, however, the total receipts were £15,373. At September 16th the total receipts from the beginning of the year were £54,278, against £54,752 last year.

Chester.—Year's Working.—The total revenue from the tramways for the year ended March 25th last was £13,382, and the working expenses were £8,590. The net balance was £903.

The Tramways Committee has decided to abolish workmen's return fares as from October 1st.

Continental.—Italy.—The Italian State Railways are introducing a new type of electric locomotive, designed as 2-C-2, for high-speed service on lines with many curves, such as those in the Ligurean Riviera. Twenty-four of these locomotives have been ordered, 18 of them from the Tecnomasio Italiano Brown-Boveri, of Milan, with the mechanical parts partly from the Officine Meccaniche, of Milan, and partly from the Stabilimento Breda, near Milan. The other six will be supplied by the Construzioni Meccaniche di Sarrono, with electrical equipment by the Maschinenfabrik Oerlikon, Switzerland. Both are designed by the State Railway Department, and the construction is substantially identical.—*Elec. Rly. Journal.*

Spain.—According to the *Gaceta de Madrid*, a concession has been granted to Don Juan Gari for the construction and working of an electric tramway between Mongat and Tiana, in the province of Barcelona.

The same issue of the *Gaceta* also notifies that the concession for the construction and working of an electric tramway from Deusto to Ibarrecolanda, in the Province of Vizcaya, has been awarded to the Compania Vizcaina de Electricidad.—*B. of T. Journal.*

East Ham.—Year's Working.—The total income of the tramways undertaking for the 12 months ended March 31st was £60,570, as compared with £55,747 for the previous year, an increase of £4,823. The expenditure for the 12 months was £51,957, an increase of £3,060 as compared with 1913-14. The gross profit was £8,613, against £6,850, the increase being represented by £4,823 extra income, less £3,060 increase in expenditure. The balance carried to the net revenue account, together with a transfer from the borough rate of £6,288, sinking fund moneys applied in lieu of permanent borrowing £522, and depreciation and renewal fund moneys of £3,535, amounted to £18,958, representing the sum available for the payment of interest on, and repayment of, debt and special expenditure. After charging interest on, and repayment of loans, including contributions to sinking funds, amounting to £12,137, together with the sum of £4,167 in respect of revenue contributions to capital expenditure during the year, and to which must be added the deficiency at the commencement of the year of £7,523, there remains a deficiency at the close of the year amounting to £4,869. £4,000 of this sum has been provided for by the rates. The Tramways Committee recommends approval of the accounts, and that the engineer and manager be directed to submit a report on the question of a revision in the present fares and stages.

Croydon.—The Tramways Committee of the B.C. reported on Monday that it had effected certain economies, and was of opinion that no further reduction of expenditure could be made without impairing the efficiency of the service. Alderman Allen (the chairman) said the only thing left was to reduce the early morning cars, which he did not think the Committee would recommend or the Council accept. As a matter of fact, they were not so well used as before the war, and were always run at a loss. Since April the increase in the tramway receipts had been £3,462. Councillor Lighton said that in nine weeks their cars had run 16,000 fewer miles and consumed 4,455 less units, but had carried 380,000 passengers more than in the corresponding period of last year. The earnings per car-mile had increased from 7·66d. to 8·89d. Answering a question, Ald. Allen said that all conductors and drivers were men unfit for military service. With the Forces are 37 per cent. of the staff as existing at the outbreak of war.

Doncaster.—Year's Working.—The accounts of the Corporation tramways department for the year ended March 31st, 1915, show that the income was £25,435, as compared with £23,224 in the preceding year, whilst the expenditures were £22,579 and £21,998 respectively, the total surplus being £2,855, as against £1,226 in 1913-14. Of the total amounts borrowed for expenditure on the undertaking, £127,825 is still owing, and under its existing powers the Corporation can still borrow £4,975 in connection with the tramways department.

Meltham.—Proposed Tramway Extension.—At a joint meeting of representatives of the Council and the South Crosland U.D.C., the question of electric tramways from Huddersfield was considered, and a unanimous desire was expressed that the cars should be run through Netherton to Meltham.

Oldham.—Female Labour.—Women car conductors are to be started shortly at a commencing wage of 25s. per week, which is the same as that paid to male conductors at the commencement.

Rawtenstall.—Female Labour.—The Tramways Committee has decided to invite applications from women desirous of becoming car conductors during the period of the war only.

Railway Electrification.—The electrification of the main line of the Chicago, Milwaukee and St. Paul Railway between Three Forks and Deer Lodge, Montana—a length of 113 miles—is approaching completion. Tests of the locomotive equipment are to be made shortly between Lombard and Three Forks, the part of the road which has some of the heaviest grades encountered on the division. The locomotives will operate from an overhead trolley on 3,000-volt direct current.—*Financial News.*

TELEGRAPH and TELEPHONE NOTES.

Austrian Telephone Service.—The Postmaster-General, Mr. Spence, states that last year there was a loss of £290,000 on the telephone service; economies have been made resulting in a saving of £90,000, but the remainder will have to be met by increasing the charges.

Illicit Wireless.—At Sydney, N.S.W., on August 5th, R. Evans was charged with having in his possession apparatus capable of being used for tapping wireless messages, and was fined £50, or, in default, six months' imprisonment.

The Telephone Service.—The increased charges for calls from public telephone call offices and the revised scale of fees for the use of the trunk telephone lines come into operation to-day.

Wireless in the Air Service.—A large number of members of the Royal Flying Corps are daily receiving training in wireless telegraphy at Marconi House, the Marconi Co. having placed practically its entire resources at the disposal of the corps.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—Sydney.—October 25th. Six electrically-operated wharf capstans, for the Sydney Harbour Trust. Forms of tender from the Engineer-in-Chief, Harbour Trust Offices, Circular Quay.*

December 6th. Municipal Council. 33,000-volt outdoor transformers and switchgear. Specifications (10s. 6d.) from Electric Light Department, Town Hall.

October 25th. For the Commonwealth Department of Defence (Navy Office). Supply, delivery and erection of power-station plant and equipment for the Commonwealth Naval Dockyard, Sydney.*

January 12th. N.S.W. Railway and Tramways Department. Two water-tube boilers, each 8,000 sq. ft. heating surface, complete with economisers, superheaters and chimney stack, for the Zara Street power house, Newcastle. Particulars, Electrical Engineer's Office, 61, Hunter Street, Sydney.—Specification (No. 468), 20s. each.—*Tenders.*

January 31st, 1916. Three electrically-operated railway freight-car transferers, for Jones Bay wharfage, Pyrmont. Particulars from Engineer-in-Chief of the Harbour Trust.

Victoria.—December 14th. P.M.G. For delivery in all States, 18,670 common-battery wall pattern telephones, manufactured in Australia. Sched. No. 1,264.

Victorian Railways.—January 5th, 1916. Installation of automatic sprinklers and thermostats at Jolimont car-shed. Chief Storekeeper, Railway Offices, Spencer Street, Melbourne.

Brisbane.—November 17th. P.M.G.'s Department. Switchboard parts, schedule 343; telegraph instruments, schedule No. 345.

Greystones (Co. Wicklow).—One 60-B.H.P. gas engine, alternator, switchboard panel for Greystones Electric Light and Power Co. See "Official Notices" to-day.

Halifax.—October 6th. Foundations for two cooling towers at the electricity works, Foundry Street. Specification, &c. (£5), from Mr. J. Lord, M.I.C.E., Borough Engineer, Town Hall.

Littleborough.—October 22nd. U.D.C. H.T. cables, road-work, &c., transformers and switchgear for sub-station. See "Official Notices" to-day.

London.—H.M. Office of Works.—October 1st. Repair of incandescent electric lamps. See "Official Notices" September 17th.

L.C.C.—October 5th. Heating and ventilating installation at Charlton Tram Depôt. Specification, &c. (£1 1s.) from Superintendent Architect's Department, Aldine House, Bedford St., W.C.

Hammersmith.—The Electricity Committee recommends that tenders be invited for the supply of seven 200-KW. transformers.

New Zealand.—Dunedin.—November 3rd. City Council. Insulated and bare copper wire for a period of two years.*

November 3rd. City Council. One 3,000-volt regulator.*

Salford.—October 4th. 20,000 pairs of carbons for the electricity department. See "Official Notices" September 24th.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Aylesbury.—The U.D.C. has accepted the tender of Messrs. E. T. Mackrill & Sons, electrical engineers, of Aylesbury, for a motor pump, at £69.

Barnsley.—The Borough Education Committee has accepted the tender of Mr. Edward Broley, of Barnsley, for E.L. work at Agnes Road Schools, at £72.

Beleek.—At a recent meeting of the District Council the tender of the Beleek Pottery Co. for lighting the town by electricity was accepted.

Bristol.—The Corporation Docks Committee has accepted the tender of Messrs. Johnson & Phillips, Ltd., for the supply of 7/16 paper-insulated, lead-covered and armoured main cable.

Bootle.—The T.C. has decided to accept a tender for about £8,000 for additional machinery at the Marsh Lane electricity works, required in consequence of the increasing output of energy for power purposes.

Buxton.—The U.D.C. has accepted the tender of the B.I. and Helsby Cables, Ltd., for the supply of two feeder pillars and four feeders, at £207.

Haslingden.—Messrs. S. S. Stott & Co., Laneside Foundry, Haslingden, have placed the contract for the electric lighting of the whole of their erecting shops, machine shops, &c., with Mr. A. M. Cramp, of Haslingden.

London.—H.M. Office of Works has accepted the tender of the Foster Engineering Co., Ltd., for 12 months' supply of metal-filament lamps under Section 1.

Bethnal Green.—The B.C. Electricity Committee recommends the acceptance of the tender of Messrs. Higginbottom & Mannock, Ltd., for two travelling cranes for the sub-stations, for £270. The only other tender received was from Messrs. Carrick & Ritchie, at £300.

Hammersmith.—The Electricity Committee has instructed the electrical engineer to negotiate a contract with the present contractors (The Main Colliery Co., Ltd.) for steam coal, for 5,000 tons of Welsh coal, to be delivered at the rate of 100 tons per week during the year ending July, 1916, at a total maximum price of 22s. 10d. per ton.

Stepney.—The Electricity Committee reports the purchase of 5,145 tons of coal, at prices varying from 17s. 9d. to 23s. per ton; and has accepted the tenders of Messrs. E. Foster & Co. for the supply of 1,200 tons of Ibstock small peas, at 20s. 6d. per ton; 3,000 tons of Ibstock double-screened nuts, at £1 2s. per ton, and 2,000 tons of Measham pearls, at 18s. 9d. per ton, to be supplied in barges at the Limehouse generating station in equal monthly quantities during 12 months. The Committee recommends that the tender of Messrs. Strachan & Henshaw, Ltd., be accepted for two extra ash-skips for the telpher track, at £67.

Wolverhampton.—The Guardians have accepted the following tenders for requirements during the half-year ending March :—

L. Andrew & Co.—Leclanché cells, metallic-filament and carbon-filament lamps.
Callender's Cable & Construction Co., Ltd.—Cable.
Edison & Swan United Electric Light Co., Ltd.—Leclanché cells, and white opal shades.

FORTHCOMING EVENTS.

Salford Technical and Engineering Association.—Saturday, October 2nd. At 7 p.m. At Royal Technical Institute, Peel Park. Paper on "The Wonders of Coal," by Mr. G. R. Kew.

Society of Engineers.—Monday, October 4th. At 7.30 p.m. At Surveyors' Institution, Great George Street, Westminster. Paper on "Law and Engineering," by Mr. S. G. Turner.

Nottingham Society of Engineers.—Wednesday, October 6th. At 8 p.m. At Welbeck Hotel. Annual Meeting.

Electro-Harmonic Society.—Friday, October 8th. At 8 p.m. At Holborn Restaurant. Smoking Concert.

NOTES.

Electro-Harmonic Society.—This Society opens its thirtieth season with a Smoking Concert at the Holborn Restaurant (King's Hall), on Friday evening, October 8th, 1915, commencing at 8 o'clock. The preliminary programme is as follows :—Mr. Joseph Cheetham, tenor; Mr. Joseph Farrington, bass-baritone; Mr. Rupert Hazell, novel instrumentalist and humorist; Mr. George Gower, banjoist; Mr. Fred Curtis, humorist; Mr. Finlay Dunn, entertainer at the piano; Mr. Bernard Flanders, A.R.A.M., solo pianoforte and accompanist. The other concerts of the season have been fixed for the following dates :—

Monday, November 15th.—Ladies' Night.
Friday, December 17th.—Smoking Concert.
Friday, January 7th.—Smoking Concert.
Monday, February 14th.—Ladies' Night.
Friday, March 17th.—Smoking Concert.

Motor-Starting by Wireless.—Starting a motor-car engine by means of wireless telegraphy is a novel idea. At the Indiana State Fair the motor of a Model 83 Overland was started every five minutes by a wireless spark from the Overland headquarters in Indianopolis, five miles away. The Overland car on exhibition at the Fair grounds was fitted up with a receiving apparatus and the necessary automatic switches and relays for throwing the electric current on and off the starter and magneto. An automatic switch was regulated so as to allow the car to run for 45 seconds, after which the magneto was cut off.—*Daily News.*

Institution and Lecture Notes.—Association of Mining Electrical Engineers (West of Scotland Branch).—On Saturday last the members of the Branch visited Auchincruive Colliery, Prestwick, belonging to Messrs. Wm. Baird & Co., Ltd. Chief interest centred in the electrical installation, which is believed to be one of the most extensive and complete in Scotland. The installation, which is on the "Thury" principle, was begun in 1908, under the direction of Messrs. Selby, Bigge & Co., and completed about four years ago. The plant included the following interesting features :—Separate colliery centre operated entirely by electric power from a central generating station, with two main winding equipments, fitted with motors of the "Thury" variable-voltage constant-current series type, mixed-pressure turbo-alternators, exhaust steam accumulator, "Thury" automatic voltage regulator, motor equipment on large ventilating fan, and a motor-generator of the fly-wheel storage type, with automatic slip regulator. After the inspection of the colliery, the company were entertained to luncheon.

University of London.—On Wednesday next, Prof. J. A. Fleming will deliver an introductory lecture on "Science in the War and After the War," at University College, at 5 p.m.

Iron and Steel Institute.—At the meeting of the Institute, last week, Sir Wm. Beardmore was elected president for next year.

Electric-Light Switching Competitions.—Messrs. A. P. Lundberg & Sons announce that their next examination and competition will be held in February, 1916; full particulars (including the exam. questions) will be published in the form of a pamphlet, which will be posted later on to all intending competitors. Money prizes, book prizes, and certificates will be awarded. Applications for the pamphlet may be sent in at any time to the firm at 477, Liverpool Road, N.

Volunteer Notes.—Engineering Institutions' Volunteer Training Corps.—

Company Orders.—By Lieut.-Col. C. B. Clay, V.D., Commandant, for week commencing October 4th, 1915 :—

Drills, 6.30 to 7.30; 7.30 to 8.30 p.m.

Monday, October 4th.—Section 1, Technical; Section 4, Squad signalling class.

Tuesday, October 5th.—Section 2, Technical; Section 3, Shooting.

Thursday, October 7th.—Section 3, Technical; Section 2, Shooting.

Friday, October 8th.—Section 4, Technical; Section 1, Squad signalling class.

Saturday, October 9th.—Company Parade, 2.30 p.m. Route march.

Arrangements have been made to share headquarters with the 4th Battalion Central London Regiment Volunteers, at Chester House, Eccleston Place (three minutes' walk from Victoria Station, Brighton Line).

3rd Batt. (Old Boys) Central London Regiment (Volunteers).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, September 30th, 1915 :—

Week-end Parades.—Saturday.—The Battalion will parade at Baker Street Station at 2.30 p.m. and proceed by route march to Wembley Camp.

Sunday.—7 a.m., Réveillé; 10 a.m., Church Parade; 10.30 a.m., "B" and "C" Companies, Instruction in Cooking; 2.30 p.m., "B" and "C" Companies, Bombing; 10.30 a.m., "A" and "D" Companies will build a single lock bridge, under the supervision of Mr. S. A. Marples.

Musketry.—Saturday next, October 2nd.—There will be Shooting at both Acton and Bisley Ranges as usual. Members proceeding to Bisley must report themselves to Sergeant Gotter at the Barrier of No. 9 Platform, Waterloo Station, at 12.45 p.m.

A. G. Joiner, *Major and Adjutant*, O.B.C.

Board of Trade Lists.—The Board of Trade Commercial Intelligence Branch records in list No. 39 applications received for manufacturers or producers of the following :—

China-ware for electrical purposes, including shades.
Opal and opal-cased bowls and hemispheres for electric light fittings.
Electrical glass shades.

List No. 40 contains inquiries for makers of small buzzers for electrical signalling and tapper clocks.

Appointments Vacant.—Switchboard attendant (27s.), for Wakefield Corporation; shift engineer (£2) for Oldham Corporation; meter tester (40s.) for Salford Electricity Works; senior and junior engineers-in-charge (£4 and £3 respectively) for Belfast Tramway and Electricity Committee. Particulars are given in our advertisement pages.

The Admiralty Metal Brokers.—Messrs. H. R. Merton & Co.—Mr. R. Pearce having asked whether Henry R. Merton & Co., Ltd., are still employed by the Admiralty as metal brokers, having regard to the facts alleged by the Solicitor-General on September 17th in the case of the s.s. *Bilbister*, in the Admiralty Prize Court; and, if so, whether such employment will cease, and when; Mr. Macnamara has replied: "The answer is in the negative."

Australia.—Agencies Wanted.—A Sydney firm wishes to take up agencies for United Kingdom manufacturers of electric lighting sets for cars and electrical fittings, lamps and sundries. Particulars can be obtained at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.

Electric Furnaces for Canada.—An order has been placed by the Canadian Brake Shoe Co., Ltd., Sherbrooke, Quebec, Canada, for the installation of a Snyder electric furnace for melting steel. This furnace will melt and refine cold material, and will deliver 24 tons per day of 24 hours. The company has been operating a steel foundry for many years, using electric furnaces exclusively for melting. It now has six furnaces of the three-electrode type in operation.—*Mining World.*

Wiring Methods in France.—A correspondent, writing to thank us for copies of the Electrical Review, says :—"It is a real pleasure to be able to keep in touch with electrical affairs. I have been much interested in the French installations I have seen over here; in some points they are very practical, and show great ingenuity, but their house installations, with flex tin-tacked to boards or ceilings without insulators, are enough to make an English inspector have a fit on the spot, that anyone should dare to take such liberties with his goddess 'Electra'!"

"Fire Warning" Posters.—The British Fire Prevention Committee's "Fire Warnings" have been mentioned in our pages from time to time in connection with the War Emergency, but the different forms of "Fire Warnings" available, and the fact that they can be obtained gratuitously, do not appear to be generally known. Over a quarter of a million posters have already been issued by the Committee, free of charge.

All communications as to "Warnings" should be in writing addressed to the Registrar, the British Fire Prevention Committee, 8, Waterloo Place, London, S.W., and not by caller or telephone.

Inquiries.—Makers of glass insulators are asked for.

Eductional.—Northampton Polytechnic Institute.—The "Announcements" recently issued for the new session indicate that the Institute is not only well equipped for educational work, but also fosters the social welfare of its students in many ways. The day courses commence on Monday next, and the evening classes have already begun. Courses are provided in civil, mechanical and electrical engineering, technical optics and horology, as well as radiotelegraphy, submarine cable work, and electrochemistry. Various additions have been made to the equipment, including special transformers and motors, a Tirrill regulator, and a mercury arc rectifier. The principal, Dr. R. M. Walmsley, is head of the electrical engineering department, with Mr. F. M. Denton as Associate Head.

Manchester Municipal School of Technology.—The prospectus of part-time courses in mechanical and electrical engineering has been received. Prof. Miles Walker is head of the department of electrical engineering, with Mr. J. Lustgarten as chief assistant, and the part-time courses, which extend over five years, are arranged for the benefit of those who, while otherwise occupied in the daytime, desire to fit themselve for responsible positions by evening study.

Borough Polytechnic Institute, Borough Road, S.E.—Re-opened on September 27th. Particulars of courses in electrotechnics are given in our advertisement pages to-day.

King's College for Women.—The Household and Social Science Department at Campden Hill has been equipped with a kitchen laboratory, in which experiments will be carried on in cooking all kinds of food by different processes; gas cookers, hay-box apparatus, electric ovens and gas ovens, fitted with separate meters, so that the students can compare the cost of fuel, are features of the central kitchen.

Wireless Telegraph Patents.—It is reported that a syndicate, representing Marconi interests, has acquired the Poulsen patent rights, and that the latter will in due course become the property of the Marconi organisation.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—A sum of 50 guineas is to be given to the electrical engineer at Bedford for work done by him outside his duties as engineer, particularly in preparing specifications and supervising work in connection with the Isolation Hospital, Corporation buildings, and all centres controlled by the Education Committee.

Reference was made at a meeting of the Falkirk Town Council to the patriotism of Mr. Ransom, the electrical engineer, who has joined H.M. Forces, and best wishes were extended to him.

Mr. A. H. Gates, having been discharged from military service, it is proposed to re-engage him as chief technical assistant at the Luton Council's electricity works, at £3 10s. per week.

Tramway Officials.—Mr. J. R. Groves, manager of the Worcester tramways, has been appointed manager of the Electric Traction Co.'s system at Gravesend and Northfleet. Mr. Groves has been at Worcester for seven years, and previously held positions at Cardiff, Great Yarmouth and Croydon.

General.—We have pleasure in offering our most cordial congratulations to Mons. Montpellier, rédacteur-en-chef of *L'Electricien*, who has been nominated to the grade of Chevalier of the Legion of Honour. At the outbreak of war he entered upon service as Chief of Section of the Central Military Telegraphs at Paris. The same honour had previously been conferred upon M. J. L. Routin, engineer to Messrs. Brégnet.

At the Catholic Church of St. Simon Stock, Putney, the marriage has taken place of Mr. Hervey J. V. Coward, who is on the staff of the Underground Railways Electric Power Station, Lot's Road, Chelsea, and Miss Minnie Victoria Morgan, youngest daughter of the late Mr. A. Houlston Morgan, of Bradley Hill (Glos.). The presents included a marble clock from the bridegrooms's colleagues.

Mr. Harold R. Nash, chief of the cable order and estimating office of the St. Helens Cable and Rubber Co., and Miss Florence H. Hill, confidential clerk to the manager and secretary of the firm, were married at the Parish Church, Lowton, on September 22nd. The staff of the cable works gave the newly-married couple a case of cutlery, and Miss Hill, who has been with the firm for 12 years, was handed an enamelled carriage clock.

At Worksop Congregational Church on September 23rd the marriage took place of Mr. E. B. Vere, electrical engineer, of Rossington, and Miss Dorothy Dawse, only daughter of Mr. H. E. Dawes, of Worksop.

Ald. Walter Phelps Gibbings, chairman of the Electricity Committee, has accepted the Mayoralty of Carlisle for the coming municipal year.

On September 25th, Mr. Rowland A. Evans, representative of the lift department at Messrs. Gimson & Co. (Leicester), Ltd., Leicester, was married to Beatrice Irene, only daughter of Mr. and Mrs. T. Merchant, of Leicester, at Dover Street Baptist Church, Rev. Rowland Evans, father of the bridgroom, performing the ceremony.

Mr. E. W. Simmons, second cost clerk in the Stepney B.C. electricity supply department, has resigned his appointment owing to a breakdown of health.

Roll of Honour.—Sergt. Thomas Hawthorne, of the 7th Lancs. Fusiliers, is officially reported wounded from the Dardanelles, but a letter from a chum states that he has been killed. He was 23 years of age, and was employed before the war at the British Westinghouse Works at Trafford Park.

Private Alec. Dunn (20), of the 7th Battalion Lancashire Fusiliers, and formerly employed at the British Westinghouse Works, Trafford Park, has been wounded in the fighting at Gallipoli.

Private A. Snelham, of the Australian Contingent, who is reported wounded and missing at the Dardanelles, served his apprenticeship with Messrs. Dick, Kerr & Co., Preston, and about three years ago went out to Australia to work in the copper mines. He is 25 years of age.

Private Samuel Gregory, of the 7th Lancs. Fusiliers, who has been killed in action, was 22 years of age, and was formerly employed by the British Westinghouse Co. at Trafford Park.

Private John Bailey, of the 6th Battn. South Lancashire Regt., has died on board ship from wounds received in action at the Dardanelles. He was employed before the war at the Warrington Corporation electricity works.

Mr. A. C. Gilling, electrical engineer to the Epsom Urban Council, who has been on active service for about nine months with the Queen's Westminsters, has returned from the Front suffering from a shrapnel wound in the head, which, fortunately, is not serious. We are pleased to learn that Mr. Gilling has, without application, been given a commission in the Royal Flying Corps, and he commences his aviation training forthwith.

Lance-Corporal A. Woodward, 7th South Staffs. Regt., who was engaged with the British Thomson-Houston Co., Ltd., Rugby, has lost his life at the Dardanelles. He was killed whilst attending to a wounded comrade.

Warrant Telegraphist Ernest A. Sutton, Royal Naval Reserve, who lost his life in the sinking of H.M. trawler *City of London*, in the North Sea, on September 14th, was formerly on the wireless staff of the Marconi Co. Later he was with the General Electric Co., Ltd., of London, where he was assistant manager of one of the departments. After the outbreak of war he offered his services to the Admiralty, and at the time of his death he was nominated for further promotion.

Intelligence has reached his home at Margate of the death from wounds received in action in the Dardanelles of Private Henry Minter, electrical engineer, who was serving with the Australian Imperial Force, which he joined at Toowoomba, Queensland, on the outbreak of war. Deceased received his training at the works of the Adams Manufacturing Co., Bedford, and he left for Queensland in September, 1911.

For conspicuous gallantry in rescuing his Section Officer under heavy fire, Sapper Ernest Jackson, of the Royal Engineers, has been awarded the D.C.M. When he enlisted Jackson, who was only 18 years of age, was with Mr. Simpson, manager of the Preston tramways.

News has been received of the death of Private Arthur Sulch, of the 5th Battalion Duke of Wellington's West Riding Regiment (Huddersfield Territorials), in the trenches in France. He was 20 years of age and was formerly employed by Mr. T. W. Broadbent, electrical engineer, of Huddersfield.

Private F. Whittaker, of the 9th Battalion West Riding Regiment, who has been missing since September 3rd, was formerly employed by the Yorkshire Electric Power Co., at Dewsbury, and enlisted in September, 1914. He went out to the Dardanelles last July.

We are sure that we voice the sentiments of a large company of electrical men when we offer to Mr. and Mrs. H. Scholey, of Bedford Park, W., and 56, Victoria Street, S.W., our very deep sympathy with them in the death of their only son—indeed, their only child—Lieut. Chas. Harry Norman Scholey, of the 9th Battalion Rifle Brigade, who was killed in action on the Western Front on Sunday last, September 26th. Lieutenant Scholey, who was 23 years of age, was educated at Uppingham, and was an undergraduate at Clare College, Cambridge, when war broke out. He received his commission through the University, and in September, 1914, was posted to the Rifle Brigade. In February he was made First Lieutenant and was given his company in August last. He won his school colours for Rugby football, and at Cambridge obtained the College colours for cricket, Rugby and hockey.

Obituary.—The interment took place last week at Chester Cemetery of the remains of the late Mr. John Gardner, general manager of the Chester Corporation tramways. The deceased, who was 64 years of age, was formerly connected with the traffic department of the Liverpool tramways, and in 1885 was appointed manager of the Chester Tramways Co. In 1901 he became general manager of the Chester Corporation tramways, and electric traction was inaugurated 18 months later.

REVIEWS.

Arithmetic of Alternating Currents. By E. H. Crapper. London: Whittaker & Co. Price 2s. 6d. net.

This little volume comprises an admirable selection of worked examples and graduated exercises (with answers) in various alternating-current exercises. Whilst it has, naturally, no particular "plot," the book is very well arranged and in every way up to the high standard we should expect from the author. It should meet fully the needs of those many students who desire guidance and material on which to practise in the way of numerical quantitative exercises. Alternating-current problems of every kind demand a good deal of mathematical working for their solution, and, though the mathematics required be comparatively simple, more practice is required to gain confidence and readiness in its application than can easily be provided for in a standard text-book on alternating-current theory. By preparing a treatise devoted specifically to the arithmetic of the subject, the author has earned the gratitude of what will, we are sure, be a very extensive circle of readers.

It is important to note that the book is much more than a mere collection of problems. At the beginning of each chapter is a brief expository introduction leading up to the particular group of problems and calculations forming the main bulk of the chapter. So successful has the author been in this respect that he has actually succeeded in making the book readable, whilst still fulfilling all the aims generally attempted unsuccessfully by the orthodox collections of "Exercises" in text-books. There are ten chapters in all, the longest being devoted to calculations relating to generation of alternating E.M.F.'s; inductive circuits; and capacity and condensers. Chapters of intermediate length are devoted to periodic and alternating quantities in general; to resistance, inductance and capacity in parallel; and to static transformers; whilst the remaining chapters deal with inductances, polyphase power, induction motors, and transformers. Altogether there are 50 worked examples and 182 exercises, and it is safe to say that any reader studying this work will find his progress made as easy and interesting as possible and will acquire, by the time he reaches the last page, a thorough grounding in the fundamental principles of a branch of electrical engineering of immense and daily increasing importance. Candidates for C. & G. examinations and other students traversing the scope of the latter will find this volume of great assistance.

Graphical Determination of Sags and Stresses for Overhead Line Construction. By Guido & Marco Semenza. (Translated from the Italian by C. O. Mailloux.) London: Hill Publishing Co. Price 12s. 6d. net.

There can be no doubt that many overhead line breakages due to the action of the elements—wind, snow, ice, cold and heat—and commonly set down as dispensations of Providence, could be averted by taking into account, when erecting the lines, those physical factors on which their stability depends. Costly high-tension transmission lines are generally erected very carefully under full recognition of the influence of atmospheric and climatic conditions, but smaller (and far more numerous) lines are usually adjusted "by eye." Expert as the line foreman undoubtedly becomes in thus securing what he considers the desirable result, it is obviously impossible for him to allow for varying atmospheric conditions from day to day and to ensure that the line shall be safe under the worst conditions arising in the locality, unless he has at his disposal some means which he can apply in the field to ascertain what sag and tension under existing atmospheric conditions will ensure safety under the worst conditions.

The claim made for the present work is that it provides "a method for determining sags and stresses which, while based rigorously and solidly upon sound scientific principles, is so simple in application and practical in use that an intelligent lineman or foreman can use it without difficulty." Since the curves permit the requisite information to be determined without calculation on the part of those using them, we believe the main object of the work is fulfilled, but it might have been fulfilled in a more satisfactory manner. As the book stands, we doubt whether any average lineman or foreman could find out how to use it for himself. The engineer in charge of the work could, however, draw up a set of instructions for the use of "practical" men hitherto unfamiliar with graphics or, at any rate, with its special phraseology. The authors' explanations, at least as presented in the translated work, are only likely to be comprehensible to the technically-trained engineer, and even the latter would find his path considerably smoothed were skeleton diagrams given in the text to illustrate the particular examples chosen for explanatory purposes. Seeing that the book is intended for field use, it would not be superfluous to print a copy of the loose temperature scales provided on one of the pages, so that, should the loose scales be lost, a fresh set could at once be prepared.

The general procedure adopted in using the charts is as follows: From the first chart a factor m is read off, according to the wind and ice load to which the line may be exposed. The actual span is multiplied by this factor to give a hypothetical span, which is subsequently adopted in reading from the later charts, the sag at given temperature corresponding to any particular tension in the line. The curves apply only to copper conductors, and in preparing them it has been assumed that the line hangs in a parabola (instead of a catenary). Other assumptions are also made to simplify matters without introducing serious error within practical limits of the quantities concerned. In order that the appropriate large scale chart may be selected quickly, an index-chart is included with the range of the individual charts demarcated by red rectangles.

The general function and character of the work are set out in Part I, which is followed by a detailed exposition of the scientific principles underlying the construction of the curves and of their mathematical evolution. This section and Part V, which gives the derivation and theoretical discussion of various formulæ used in Part III, badly need revision, for misprints are frequent and the keying of the symbols used is very unsatisfactory. The trained engineer, who alone could attempt to read these sections of the book, will not find any great difficulty in making the necessary amendments; but that does not excuse their being necessary. It is only fair to add that the charts can be used without any reference to the defective mathematical sections. Part III gives instructions for and examples of the practical use of the charts, and should, in our opinion, be simplified in phraseology and supplemented by explanatory diagrams. Part IV is very useful, giving, as it does, information regarding allowances in various countries for the effect of wind and ice load on stresses and sags in overhead lines.

This book and the charts which it introduces should be very useful to all engineers engaged in overhead constructional work, and it is particularly unfortunate that the present edition should include blemishes which could easily have been avoided, and which, while in no sense vital, must prove annoying to the reader.

NEW COMPANIES REGISTERED.

Institute of Industry (of Great Britain and Ireland), Ltd. (141,643).—This company was registered on September 22nd as a company limited by guarantee with an unlimited number of members, each liable for £5 in the event of winding-up, to promote, increase and develop the industrial, scientific, financial and commercial activity of the United Kingdom of Great Britain and Ireland, and His Majesty's Overseas Dominions, Colonies, Dependencies and Possessions, and generally to further and encourage inter-Imperial trade throughout the British Empire by all lawful means, and to capture, retain and develop branches of industry, trade and commerce which have fallen into the hands of those who are now alien enemies of Great Britain, to watch over the interests of non-alien traders in connection with rates charged by railway and shipping companies and other carriers for the conveyance of goods, and to endeavour to obtain the removal or reduction of all unfair or excessive rates, tolls and charges. The subscribers are:—S. R. Illingworth, Fern Villa, Chesham Bois, Bucks., chemist; W. P. Thomson, Hatton Court, E.C., chemist; J. Hay, 138, Leadenhall Street, E.C., merchant; Sir H. H. Bartlett, 56, Victoria Street, S.W.; A. H. Norton, 2, Eldon Street, E.C., consulting engineer; Sir James Heath, Bart., Oxenden Hall, Market Harborough; J. Taylor Peddie, 39, Murray Road, Wimbledon, S.W., director. The subscribers to the memorandum of association and such following named persons as shall consent to become members shall be the first members of the Institute: Sir William Beardmore, Bart., Sir Clifford J. Cory, Bart., Arthur du Cros, J.P., M.P., C. Johnson, G. A. Wills, G. McLaren Brown, and Sir George Watson, Bart. The management is vested in a Court of Directors. The first directors are: Sir H. H. Bartlett, Bart., 56, Victoria Street, Westminster, builder and contractor; Sir William Beardmore, Bart. (Messrs. W. Beardmore & Co., Ltd.), Glasgow, shipowner; Sir Clifford Cory, Bart., 98, Mount Street, W., colliery owner and coal merchant; Arthur du Cros, J.P., M.P., 14, Regent Street, W., motor-car manufacturer; L. Evans, "Russell," near Watford, Herts., paper manufacturer; Sir James Heath, Bart., Oxenden Hall, Market Harborough, ironmaster; G. B. Hunter, "The Willows," Clayton Road, Newcastle-on-Tyne, shipbuilder; C. Johnson (The Rolls-Royce Co., Ltd.), Conduit Street, W., motor-car manufacturer; J. W. Macdonald (Messrs. Henry Tate & Sons, Ltd.), Silvertown, E., sugar refiner; W. J. Noble, Bath House, Putney Heath, S.W., shipowner; J. Taylor Peddie, 39, Murray Road, Wimbledon, S.W., director; Sir Adolph Tuck, Bart. (Messrs. Raphael Tuck & Sons), Moorfields, E.C., publisher; J. Turner (Messrs. Read, Holliday & Sons, Ltd.), Huddersfield, dye manufacturer; Sir William G. Watson, Bart., Salhampstead House, near Reading, company director; G. A. Wills, "Burwalls," Leigh Woods, Clifton, Bristol, tobacco manufacturer; G. Maclaren Brown, The Canadian Pacific Railway Co., Charing Cross, S.W., railway manager; W. Deakin, "Thornleigh," Oakfields Road, Selly Park, Birmingham, engineer; S. R. Illingworth, Fern Villa, Chesham Bois, Bucks., chemist; T. C. Moore, Shelton, Stoke-on-Trent, pottery manufacturer; A. Home-Morton, 2, Eldon Street, E.C., consulting engineer. Until otherwise determined the entrance fee payable on election shall be five guineas in the case either of an individual member, not being a representative member; ten guineas in the case of a partnership firm, company or corporation with a paid-up capital not exceeding £200,000, or by any unincorporated association or body not having a share capital, or by a member representative of any partnership, company, corporation, or association with a paid-up capital exceeding £200,000; but no entrance fee shall be payable by any of the first thousand members of the Institute (including the subscribers to the memorandum of association). Solicitors: Rutter, Veitch & Bond, Norfolk House, Norfolk Street, Strand, W.C. Secretary: L. Atkinson, Aldwych Site, W.C. Registered office: Exhibition Buildings, Aldwych Site, Strand, W.C.

Electrode Company of Sheffield, Ltd. (141,654).—This company was registered on September 23rd, with a capital of £40,000 in £1 shares, to manufacture, buy, sell and otherwise deal in carbon and other electrodes used in connection with electric furnaces and other materials and appliances for the manufacture of steel and alloys or otherwise, which can conveniently be made or dealt with in connection or simultaneously therewith; also to carry on the business of general merchants, ironmasters smelters, engineers, etc. The subscribers (with one share each) are: D. Vickers, River Don Works, Sheffield, steel manufacturer; W. C. Whiteley, Wood Hall, Sheffield, steel manufacturer; H. Peile, Milburn House, Newcastle-on-Tyne, alloy manufacturer; W. H. Ellis, Westwood, Ecclesall, Sheffield, civil engineer; F. C. Fairholme, Netherhall, Hathersage, Derbyshire, civil engineer; I. B. Milne, Cross Grove House, Totley, near Sheffield, metallurgical director; C. W. Kayser, Eaton Hall, near Retford, steel manufacturer.

Private company. The number of directors is not to be less than four or more than ten; every shareholder or group of shareholders holding 4,000 shares shall be entitled to nominate a director in respect of each complete 4,000 shares held. The following are the first directors nominated by the firms whose names are given in parentheses: D. Vickers and W. Clarke (Vickers, Ltd.); H. Peile (Newcastle Alloy Co.); W. H. Ellis (John Brown & Co., Ltd.); F. C. Fairholme (Thomas Firth & Sons, Ltd.); I. B. Milne (Hadfields, Ltd.); C. W. Kayser (Kayser, Ellison & Co., Ltd., and Samuel Osborne & Co., Ltd.). The directors for the time being may co-opt other directors, but so that the maximum number is not exceeded and that such co-option shall not interfere with the rights of individual shareholders under the above provisions. Solicitors: G. E. Branson, 9, Bank Street, Sheffield. Registered by Jordan and Sons, Ltd., 116-7, Chancery Lane.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Brilliant Sign Co. (1907), Ltd.—Mortgage and Land Registry Charge on Paragon Works, Uxbridge Road, Shepherd's Bush, both dated September 9th, 1915, to secure all moneys due or to become due from the company to Capital and Counties Bank, Ltd., 39, Threadneedle Street, E.C. Also debenture, and as collateral security thereto, a mortgage, both of even date, to secure £9,000, charged on company's undertaking and property, present and future, including uncalled capital. Holders: Capital and Counties Bank, Ltd., 39, Threadneedle Street, E.C.

Tyer and Co., Ltd.—A memorandum of satisfaction in full on September 11th, 1915, of debentures dated March 10th, 1913, securing £7,000, has been filed.—Particulars of £15,000 debentures, created September 14th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, the whole amount being now issued. Property charged: The company's undertaking and property, present and future, including uncalled capital. No trustees.

Banbury and District Electric Supply Co., Ltd.—A memorandum of satisfaction in full on December 31st, 1914, of debentures dated March 26th, 1913, securing £200 has been filed.

Sheerness and District Electric Power and Traction Co., Ltd.—A memorandum of satisfaction in full on January 1st, 1915, of debentures dated December 8th, 1914, securing £315, has been filed.

Imperial Light, Ltd.—A memorandum of satisfaction to the extent of £2,600 (being amount outstanding) on September 14th, 1915, of debentures dated November 7th, 1910, securing £5,000, has been filed.

Oriental Telephone and Electric Co., Ltd.—A memorandum of satisfaction to the extent of £1,200 on September 15th, 1915, of debenture stock secured by trust deed dated June 28th, 1905, and supplemental deed of acknowledgment dated June 12th, 1907, securing £200,000, has been filed.

Telephone Co. of Egypt, Ltd.—A memorandum of satisfaction to the extent of £700 on September 15th, 1915, of debenture stock, secured by trust deed dated July 27th, 1904, and three supplemental deeds of acknowledgment dated February 21st, 1906, March 4th, 1908, and October 27th, 1909, securing £200,000, has been filed.

CITY NOTES.

Dundee, Broughty Ferry and District Tramways Co., Ltd.

Presiding over the annual meeting, Mr. George Balfour, the Chairman, replied to the criticism directed against the company in connection with the taking over of part of the line by the Corporation of Dundee. He deprecated what he characterised as the wild statements on the part of members of the Town Council before the true facts of the case were known, and he maintained that no fault lay with the company in connection with the trouble that had arisen. Continuing, he said the year ending July 31st had been a particularly troublesome one, and the direct effects of the war were reflected in the decreased receipts, the receipts from all sources being £13,293, or approximately £700 less than the previous year. In addition to decreased receipts, expenses had increased, the principal increase being in connection with fuel, which cost about £400 more than in the previous year, the decrease in receipts and the increased cost of fuel accounting for the difference of nearly £1,100 in gross profit, viz., £5,284, compared with £6,328 for the previous year. In moving the adoption of the report and the accounts, Mr. Balfour said the directors did not recommend payment of any dividend on the ordinary shares for last year, and they were certain that this would be approved by the shareholders. The decrease in profits would not alone have determined the directors to pass the ordinary share dividend, but the decrease in profit, coinciding with the altered conditions of running and the prevailing uncertain outlook, made it essential to adopt a cautious policy.

The motion was adopted.

The Petrograd Electric Lighting Co. of 1886.

The report for 1914 of the Petrograd Electric Lighting Co. of 1886, the situation of which has occupied a large amount of public attention during the past twelve months in consequence of German interests in the undertaking, stated that the participation of German capital and the activity of German subjects in the administration of the company down to the outbreak of war had been made the pretext by the Moscow City Council for representing that the working of the Moscow station was irreconcilable with the public interests, and asking for the liquidation of the company. As, however, it could be proved that the majority of the company's shares belonged to Swiss subjects, the company expressed the hope that the Government would limit its action to the placing of the company under special State control. Since the end of November the company had been without any communication with the works at Lodz, and the working results of the latter had, therefore, only been included to the close of that month. As a consequence of the war, the consumption of energy by a number of industrial companies had experienced a diminution, although the decrease was more than counterbalanced by the connection of new works which were chiefly engaged on army contracts.

The increase in the share capital to £5,000,000 which was resolved upon in January, 1914, had been carried out by the issue of new shares for £1,000,000 shortly before the outbreak of the war, each new share being entitled to one half of the dividend devolving upon the old shares. Concerning the participation of the company in other undertakings, the report mentioned that 70 per cent. of the share capital of £1,200,000 of the Imatra Co. for the Distribution of Electrical Energy, of Brussels, had been paid up down to the occurrence of hostilities, and had been mostly employed in the works of the Russian Overland Central Stations Co. and in connection with the site and rights of the hydro-electric works at the Vuoksen Falls in Finland. The works at Bogorodsk of the Moscow Electric Power Transmission Co., of Petrograd, were brought into operation in February, 1914, and were working satisfactorily, but no information was available respecting the works at Sosnowice, which were to have been started in the autumn of 1914.

If 10 roubles are accepted as the equivalent of £1 sterling, the accounts for 1914 show gross receipts of £1,661,200, as compared with £1,371,200 in the preceding year, whilst the working expenses were £804,700 and £643,500 in the two years respectively. After deducting general expenses, taxes, loss in exchange, etc., the net profits are returned at £683,800, as against £603,500 in 1913. It is proposed to pay, as was announced two or three months ago, 11 per cent. on the preference capital, as in the previous year, and 8 per cent. on the ordinary shares, as in 1913. Owing, however, to the situation created by the war, it is proposed to place the £387,000 required for the payment of the dividends to a special account, the period for the actual distribution being left to the discretion of the directors.

Russian Companies.

The Moscow Electric Power Transmission Co. (Electroperodatscha), in which the Petrograd Electric Lighting Co. of 1886 is interested, incurred a loss of £21,000 in 1914 on a share capital of £600,000, this being the second working year.

The Russian Overland Central Stations Co. has declared a dividend of 4 per cent. for 1914 on share capital of £400,000.

The Russian Dynamo Co., of Moscow, has decided to pay 4 per cent. on ordinary share capital of £400,000 for 1914.

The Russian Wireless Telegraphy Co. has resolved to divide 15 per cent. on the ordinary capital of £300,000 for 1914.

The Petrograd Electrical Installations Co., which, in conjunction with the 1886 company and the Belgian Co., supplies energy in the Russian capital, has decided to distribute 10.2 per cent. on share capital of £1,160,000 for 1914.

The Riga Tramway Co. intends to pay 8 per cent. for the past year.

Lower Thames Land and Power Co.—The *Financial Times* states that, subject to the consent of the Treasury being obtained (formal application has already been made for the necessary sanction), it is reported that the County of London Electric Supply Co. has decided to offer to its share and debenture-holders an opportunity of participating in an issue of debentures relating to a new enterprise to be known as the Lower Thames Land Development and Power Co., Ltd. The property to be owned by this concern will consist of 308 acres of land at Barking, an option over which was acquired some little time ago on what are regarded as favourable terms. Apparently only a comparatively small proportion of the area in question will be required for the purposes of a generating station, and the remainder of the property will be dealt with by the new company in a manner suitable to the general scheme which it has in view. The authorised debenture issue of the new concern is £100,000, carrying interest at 5½ per cent., and constituting a first mortgage for 25 years. Of this total it is proposed to offer £80,000 for subscription at par. The County of London Electric Supply Co. will guarantee unconditionally the capital, interest and sinking fund. Statements which have appeared in print to the effect that the foregoing scheme has some bearing upon the pre-war project for the consolidation of the electric lighting and power industry of London are believed to be erroneous.

Our contemporary in its issue of Wednesday states that the formation of the Lower Thames Land, &c., Co., has no bearing on electrical enterprise. The company has been created merely for the purpose of purchasing and developing a building site at Barking, while, incidentally, a portion of this site is to be leased to the County of London Co., who come into the matter solely as intermediaries.

German Electrical Companies.

The *Kabelwerk Rheydt* proposes to pay a dividend of 18 per cent. for 1914-15, as compared with 12 per cent. in the preceding year, and the Elektrizitatswerk Westfalen 6 per cent., as against 4 per cent.

The *Bergmann Elektrizitats Unternehmungen, of Berlin*—the financial organisation of the Bergmann Electricity Works Co., which discontinued the negotiation of fresh business in 1912—earned gross profits of £5,300 in 1914-15, as compared with £15,500 in the previous year, the net surplus being £441, as against £9,500 in 1913-14. The debit balance brought forward has, consequently, been reduced to £26,700 on a share capital of £300,000.

The directors of the *Elektrometallurgische Werke, of Horrem, A.G.*, which company was formed two years ago by the Metal Bank and the Griesheim-Elektron Co., report that the year 1914 was part of the preparatory period. After setting aside £1,400 for depreciation, the accounts indicate a loss of £3,300 for the year, thus increasing the debit balance to £5,600 on an ordinary share capital of £50,000.

The *Brandenburg Carbid und Elektrizitats Werke A.G., of Berlin*, in reporting an increase in the gross profits in 1914-15, states that the expansion was due both to the supply of electricity and the production of carbide in Germany, and by the Norsk (Norwegian) Elektrokemisk Aktieselskab. The sales of electricity advanced from 4,400,000 KW.-hrs. in 1913-14 to 4,900,000 KW.-hrs. last year, despite the prejudicial effects of the war, whilst as a consequence of the favourable water conditions the output of carbide in 1914-15 was considerably greater than in the previous year, both at the inland works and at those of the Norwegian company, which was able to pay 14 per cent. for 1914, as compared with 6 per cent. in 1913. The gross profits of the Brandenburg company amounted to £26,000, as against £23,000, and the net profits to £15,000, as contrasted with £9,100. It is proposed to pay a dividend of 7 per cent. on a share capital of £175,000, this comparing with no distribution in 1913-14.

The shareholders in the *Deutsche Popelampen A.G., of Aix-la-Chapelle*, have decided to dissolve the company, whose working in 1914-15 resulted in a loss of £8,400. According to the report submitted at the recent meeting, the fifth year's trading closed with a considerable loss, because the conditions of trade had become more difficult for wire lamps in so far that consumers would only purchase approved wire lamps, whilst the war had rendered it impossible to obtain raw materials and trained workers. The directors had, therefore, been compelled to dispose of the glow lamp machinery. It had, however, been possible to find a market abroad, although at unfavourable prices, for most of the so-called lamps of second quality, as they would have become worthless if kept in stock for a long time. The insulating tube department developed down to the outbreak of the war so that large profits could have been reckoned on, but it could not be continued owing to the lack of raw materials, which were requisitioned by the military authorities, and the department for welding materials yielded profits which were too small to be of importance to the undertaking as a whole.

STOCKS AND SHARES.

TUESDAY EVENING.

The brilliant work of the British and French Armies announced at the beginning of the week has had the effect of neutralising the dullness produced by the Budget, the Bulgarian uncertainties, and other such influences. The long-expected advance appears to have started, and the news received on Sunday is accepted in the City as the first instalment of what are confidently hoped to be several chapters of steady pressure forward. Once more we are all amateur generals; and the armchair critics of our various newspapers are, for the time being, regarded as of little account.

From the point of view of prices, the change has been less marked in them than in sentiment. The Stock Exchange atmosphere has altered from dulness and depression to cheerfulness and light. Buying has been stimulated to some extent, but it is not surprising that markets should require more support than they have received hitherto before they can go substantially better. The American rate of exchange is still, it is evident, giving the Anglo-French Commission a good deal of trouble, but that New York considers the issue of the loan as good as made is apparent enough from the boom which is taking place in American rails, and in securities of all kinds on that side of the water. The shares of industrial companies, in particular, are soaring—electrics with the rest; and the huge amount of money which the States is making out of the war is reflected in marked Stock Exchange activity.

On this side, the County of London Electric Supply Co. is offering to its shareholders and debenture holders an amount of £80,000, in 5½ per cent. 25-year first mortgage bearer debentures, in a new company to be called the Lower Thames Land Development & Power Co., Ltd., which has a nominal capital of £100,000. The County Co., according to the circular in front of us, has exercised its option for the purchase of about 300 acres of land at Barking, with river frontage, for the erection of a new power station; but as the company will require only a certain portion of this land for generation purposes, the other undertaking has been formed to acquire and develop the whole property. The debentures are being offered at par. The principal and interest in the new concern will be guaranteed unconditionally by the County of London Electric Supply Co.; and as the annual amount for interest and sinking fund under the guarantee is £6,550, and the surplus profits of the County Co. for the year ended December last were £106,000, there is no question of the soundness of the security.

The electric lighting market is comatose. Metropolitans have gone back to 2½, a fall of ½, but County preference retain their rise of last week, and other shares in the market are just steady. Little trade is being done in any of the shares.

In the telegraph section, a fall of 10 points in Indo-Europeans has dropped the price to 40. Shares changed hands as low as 34½ about a week ago, but these apparently have been taken by purchasers at 39½ and 40; so that, incidentally, it might be assumed that somebody made a handsome profit. The purchaser, however, might quite fairly retort that he was taking a big risk in buying the shares at all, inasmuch as the immediate future of the company, from the dividend point of view, is somewhat undecided. Supposing the current dividend to be maintained, however, the yield on the money comes to 8¼ per cent. at 40, from which it is obvious that plenty of margin exists for a reduction in the rate distributed at present. Westerns are better at 12; Eastern Extensions and Eastern Telegraph ordinary have both hardened a trifle.

The fact of the income-tax being raised to 3s. 6d. cannot fail to direct attention to the companies which pay their dividends free of tax. This practice is followed by various telegraph companies, as indicated in our lists, but there is nothing to guarantee, of course, that in any half-year all the companies, or any one of them, may not depart from their present method, and in future send out their dividends less tax. It is often asked why all companies do not pay their dividends tax free, but very little consideration suffices to show that there are several sound reasons against their doing so. The one which tells probably more than the rest, however, is that a company can pay a higher rate less tax than it can if it declares its dividend free; and with the tax on unearned incomes standing at 3s. 6d. in the £1, 5 per cent. free of tax, to take an example, is equal to practically 6 per cent. gross. And it cannot be gainsaid that 6 per cent. does look better than 5 per cent., although actually the result may be the same if the dividends are paid gross and net respectively.

The Home Railway market is taking a turn for the better on the whole, but Electrics are weak, and further falls have occurred in Metropolitans, in Districts and in Underground Electric "A" shares, while the income bonds of the last-named company remain about 71. The market is regaining a little of the confidence that was handled so roughly by the threatened coal strike and railway trouble, but investors are not keen on putting money into these securities now. It is possible there will be a further reduction in prices before the Home Railway market really arrives at something like a steady level.

The question of Excess Profits Tax has raised a storm of doubt and discussion in business circles. Those who have most closely studied Mr. McKenna's speeches are at one in declaring their inability to elucidate the knotty points. The text of the Finance Bill, when it appears, will probably throw light upon the subject. Various companies connected with the electrical industry are expected to come within the clause; and while it may make a considerable difference to those concerns which have been doing well out of the war, it may also affect others, the profits in which have risen, although for causes entirely removed from the all-prevailing factor.

Manufacturing shares in the electric market are somewhat irregular in price. Edison & Swans have fallen to half-a-sovereign; India-Rubber shares weakened to 8, a drop of ¾; and Henleys at 12½ show a fall of £1. Allowing for the fact that the dividend on Henleys is paid free of tax at present, the yield at 12½ is the substantial one of £9 2s. per cent. on the money.

For the time being, we leave our calculations of yield practically unchanged, because they are worked out on the convenient basis of an income tax of 2s. 6d. in the £, and for the calendar year January 1st to December 31st, 1915, the rate actually comes to 2s. 8d. in the £ in the great majority of cases.

One of the features of the last day or two is a meteoric rise in American Marconis, which lifted the price from 15s. to 19s. 6d. The buying emanated mostly from the United States, and was confined to these particular shares, the parent Marconis and Canadian Marconis failing to obtain any benefit from the jump in Americans. It is freely stated that the American Marconi Co. is doing extremely well, and, in addition, there is a New York boom, already referred to, in the shares of nearly all the railroad and industrial companies.

The armament market is firm, on an excellent report published by the Birmingham Small Arms Co. Rubber shares, after being a dull spot, have taken a turn for the better. Business in both sections, however, is meagre. There is some improvement amongst copper shares, in consequence of the demand from America, but base metal issues on the whole continue to show heaviness.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Sept. 28, 1915.	Rise or fall this week.	Yield p.c.
Home Electricity Companies.				
Brompton Ordinary	10	7½	—	£6 13 4
do. 7 per cent. Pref.	7	7½	—	4 16 7
Charing Cross Ordinary	5	8⅝	—	6 13 4
do. do. do. 4½ Pref.	4½	8⅞	—	6 0 0
do. do. City Pref.	4½	8⅞	—	6 0 0
do. 4 Deb.	4	80	—	5 0 0
Chelsea	5	4½	—	5 17 8
do. 4½ Deb.	4½	88	—	4 17 10
City of London	9	12½	—	7 7 0
do. do. 6 per cent. Pref.	6	10⅞	—	5 11 4
do. do. 5 Deb.	5	100	—	5 0 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10½	—	6 16 7
do. do. 6 per cent. Pref.	6	10½	—	5 14 8
do. do. 1st Deb.	4½	90	—	5 0 0
do. do. 2nd Deb.	4½	85	—	5 6 0
Kensington Ordinary	9	6½	—	7 4 0
London Electric	4	1⅜	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	6 6 4
do. do. 4 Deb.	4	80	—	5 0 0
Metropolitan	8½	2¾	— ¼	7 15 7
do. 4½ per cent. Pref.	4½	8¾	—	6 0 0
do. 4½ Deb.	4½	90	—	5 0 0
do. 3½ Deb.	3½	70	—	5 0 0
St. James' and Pall Mall	10	6⅝	—	7 8 2
do. do. do. 7 per cent. Pref.	7	6¼	—	5 12 0
do. do. do. 3½ Deb.	3½	70	—	5 0 0
South London	5	2¾	—	6 19 0
South Metropolitan Pref.	7	1⅞	—	6 14 0
Westminster Ordinary	9	6¾	—	6 13 4
do. 4½ Pref.	4½	4½	—	5 9 0
Telegraphs and Telephones.				
Anglo-Am. Tel. Pref.	6	98½	—	6 2 0
do. Def.	1½	22	—	6 16 4
Chile Telephone	8	6½	—	6 3 0
Cuba Sub. Ord.	5	8	— ½	6 5 0
do. Pref.	10	15	—	6 13 4
Eastern Extension	7	12	+ ⅛	*6 18 4
do. 4 Deb.	4	80	—	5 0 0
Eastern Tel. Ord.	7	116	+1	*6 18 0
do. 3½ Pref.	3½	66	—	5 6 0
do. 4 Deb.	4	80	—1	5 0 0
Globe Tel. and T. Ord.	6	9⅜	—	*7 0 8
do. Pref.	6	9⅜	—	6 3 0
Gt. Northern Tel.	22	33	—	6 13 4
Indo-European	13	40	—10	8 2 6
Marconi	10	1⅞	—	5 6 8
New York Tel. 4½	4½	99	+ ½	4 11 0
Oriental Telephone Ord.	10	1⅛	—	5 8 1
do. Pref.	6	1⅜	—	5 6 8
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅜	—	*8 6 6
do. Pref.	5	4⅞	—	5 2 7
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12	—	*6 13 4
do. 4 Deb.	4	80	—1	5 0 0
Home Rails.				
Central London, Ord. Assented	4	70	—	5 14 4
Metropolitan	1½	28	— ½	5 8 8
do. District	Nil	13½	— ½	Nil
Underground Electric Ordinary	Nil	1⅜	—	Nil
do. do. "A"	Nil	5/6d.	—3d.	Nil
do. do. Income	6	71	—	*9 11 8
Foreign Trams, &c.				
Anglo-Arg. Trams, First Pref.	5½	8⅜	—	7 6 8
do. 2nd Pref.	6½	9½	—	8 9 2
do. 4 Deb.	4	73	—	5 9 7
do. 4½ Deb.	4½	72	—	6 5 0
do. 5 Deb.	5	74	—	6 15 2
Bra Tractions	5½	49	+1½	7 2 10
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	87	—	5 3 0
Mexico Trams	Nil	33	—	Nil
do. 5 per cent. Bonds	—	40	—	Nil
do. 6 per cent. Bonds	—	85	—	Nil
Mexican Light Common	Nil	25	—	Nil
do. Pref.	Nil	80	—	Nil
do. 1st Bonds	—	40	—	—
Adelaide Sup. 6 per cent. Pref.	6	5	—	6 0 0
do. 5 Deb.	5	98	—	5 2 0
Manufacturing Companies.				
Babcock & Wilcox	14	2⅛	—	6 8 5
British Aluminium Ord.	5	1⅛	—	4 14 1
do. Pref.	6	18/3	—	6 9 9
British Insulated Ord.	15	10⅝	—	7 1 2
do. Pref.	6	5⅜	—	5 2 2
British Westinghouse Pref.	7½	33/-	+6d.	9 1 10
do. 4 Deb.	4	70	+2	5 14 4
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11	—	6 16 4
do. 5 Pref.	5	4½	—	5 11 8
do. 4½ Deb.	4½	92	—	4 17 9
Castner-Kellner	15	61/-	—	4 18 6
Edison & Swan, £3 pd.	Nil	10/-	—1/-	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	58	—	6 18 0
do. do. 5% Deb.	5	60	—	8 6 8
Electric Construction	6	13/-	—	9 4 8
do. do. Pref.	7	19/-	—	7 7 4
Gen. Elec. Pref.	6	9½	—	6 6 4
Henley	20	12½	—1	*9 2 0
do. 4½ Pref.	4½	4½	—	5 0 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	5	8	— ½	6 5 0
Telegraph Con.	20	31	—	7 15 0

* Allowance made for dividends being paid free of income-tax.

County of Durham Electrical Power Distribution Co., Ltd.—A financial contemporary states that the directors have decided not to declare an interim dividend on the preference shares.

Lancashire Dynamo and Motor Co., Ltd.—Interim dividend at the rate of 6 per cent. per annum (3 per cent. actual), the same as a year ago.—*Times.*

MARKET QUOTATIONS.

It should be remembered, in making use of the figures appearing in the following list, that in some cases the prices are only general, and they may vary according to quantities and other circumstances.

Wednesday, September 29th.

CHEMICALS, &c.		Latest Price.	Fortnight's inc. or Dec.
a Acid, Hydrochloric	per cwt.	..	..
a " Nitric	"	..	..
a " Oxalic	per lb.	1/-	..
a " Sulphuric	per cwt.	..	..
a Ammoniac Sal	"	..	..
a Ammonia, Muriate (large crystal)	per ton	£44	£4 inc.
a Bleaching powder	"	£9	..
a Bisulphide of Carbon	"	£23	..
a Borax	"	£23	..
a Copper Sulphate	"	£28	..
a Lead, Nitrate	"	..	..
a " White Sugar	"	..	..
a " Peroxide	"	..	..
a Methylated Spirits	per gal.	..	..
a Potassium, Bichromate, in casks	per lb.	8½d.	..
a Potash, Caustic (88/90 %)	per ton	..	..
a " Chlorate	per lb.	1/4½	..
a " Perchlorate	"	1/6	..
a Potassium, Cyanide (98/100 %) (for mining purposes only)	"	Nom.	..
a Shellac	per cwt.	65/-	..
a Sulphate of Magnesia	per ton	..	..
a Sulphur, Sublimed Flowers	"	£11 10	..
a " Recovered	"	£8	..
a " Lump	"	£8 10	..
a Soda, Caustic (white 70/73 %)	"	..	..
a " Chlorate	per lb.	1/3½	½d. inc.
a " Crystals	per ton	45/-	..
a Sodium Bichromate, casks	per lb.	5½d.	½d. inc.
METALS, &c.			
b Aluminium Ingots, in ton lots	per ton	..	..
b " Wire, in ton lots (1 to 14 S.W.G.)	"	..	..
b " Sheet, in ton lots	"	..	..
p Babbitt's metal ingots	"	..	..
c Brass (rolled metal 2' to 12' basis)	per lb.	1/0½ to 1/1	..
c " Tubes (solid drawn)	"	1/0½ to 1/1	..
c " Wire, basis	"	1/1½ to 1/1½	..
c Copper Tubes (solid drawn)	"	1/1 to 1/1½	..
g " Bars (best selected)	per ton	£96	£2 dec.
g " Sheet	"	£96	£2 dec.
g " Rod	"	£96	£1 dec.
d " (Electrolytic) Bars	"	£88	£5 inc.
d " Sheets	"	£106	£5 inc.
d " Rods	"	£95	£5 inc.
d " H.C. Wire	per lb.	11½d.	½d. inc.
f Ebonite Rod	"	8/-	..
f " Sheet	"	2/6	..
n German Silver Wire	"	1/10	..
h Gutta-percha, fine	"	6/10	..
h India-rubber, Para fine	"	2/4½	½d. dec.
f Iron Pig (Cleveland warrants)	per ton	64/10	..
f " Wire, galv. No. 8, P.O. qual.	"	£26	..
g Lead, English Pig	"	£25	£1 inc.
g Mercury	per bot.	£16 5 to £16 7 6	..
e Mica (in original cases) small	per lb.	6d. to 8/-	2d. to 6d. in.
e " " " medium	"	8/6 to 6/-	6d. to 1/- in.
e " " " large	"	7/6 to 14/- & up.	1/- to 3/6 in.
o Nickel, sheet, wire, &c.	"	Nom.	..
p Phosphor Bronze, plain castings	"	..	..
p " " rolled bars & rods	"	..	..
p " " rolled strip & sheet	"	..	..
o Platinum	per oz.	110/-	5/- inc.
d Silicium Bronze Wire	per lb.	1/3	..
r Steel, Magnet, in bars	per ton	£35	..
g Tin, Block (English)	"	£153 to £154	..
n " Wire, Nos. 1 to 16	per lb.	2/7	..
p White Anti-friction Metals	per ton	..	..
k Zinc, Sh's (Vieille Montagne bnd.)	"	Nom.	..

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d Frederick Smith & Co.
e F. Wiggins & Sons.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
l Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Winnipeg Electric Railway Co. — A dividend of 2½ per cent. for the quarter ending September 30th, 1915, being at the rate of 10 per cent. per annum, is announced.

Madras Electric Tramways (1904), Ltd. — The directors have declared an interim dividend at the rate of 6 per cent. on the preference shares.

Globe Telegraph and Trust Co., Ltd.—The directors have declared a first interim dividend of 2s. per share, free of income-tax, on the ordinary shares.

Kalgoorlie Electric Power and Lighting Corporation, Ltd.—A dividend on the preference shares at the rate of 4 per cent. per annum for the six months ending 30th inst. has been declared.

Russia.—The Bielostock (Russia) Electrical Co., capital 2,000,000 roubles, made a profit in its second (1914) working year of 182,067 roubles; 100,000 roubles (or 5 per cent.) will be distributed in dividend.

THE PROBLEM OF THE "POINT-FIVE" TARIFF.

[COMMUNICATED.]

THE "point-five" tariff—officially defined as any scheme under which energy for heating and cooking is obtained at 0·5d. per KW.-hour, with or without a preliminary fixed charge—has undoubtedly come to stay. The number of "point-five" supply areas increases steadily, the heating and cooking connections therein increase rapidly, and it seems no over-statement of the case to say that really important development in domestic heating and cooking depends on energy being available at 0·5d. per unit (or less). The important point is to have a cheap rate for actual consumption; this is an invaluable asset to canvassers, and eliminates consumers' dissatisfaction due to high bills caused by current wastage which, in the form it usually takes, is not expensive to the supply station.

One may safely look forward to the number of "point-five" undertakings being very materially increased in the near future (for domestic heating and cooking apparatus seems at last to be emerging on a commercially and technically satisfactory basis), and it is, therefore, worth while paying attention to the fixed charge which supplements the ½d. a unit tariff. The ideal arrangement would naturally be to supply all energy at a single flat rate, and there is no reason why this should not be approached as station load factors increase. It seems quite certain, however, that a uniform flat rate can only be justified by practically a 100 per cent. station load factor, since no improvement in storage cells can make storage of electrical energy as simple, cheap, and efficient as the purely mechanical storage of gas in gasometers. In this respect, gas supply engineers have a very material advantage over electricity canvassers, who find it a perplexing task to explain to the lay mind why current for power should cost so much less than current for lighting.

However, the fact remains that for the present a charge of ½d. per unit consumed for heating and cooking must in practically every case be supplemented by a fixed charge. To levy this indirectly, by stipulating that so many lamps be installed and operated on the ordinary lighting tariff, requires duplex wiring, and at once rouses the consumer's suspicion that he is being badly "done" on the lighting units. As a matter of fact, there is a very excellent reason for selling current at different rates at different times of day, but if this be applied to the cooking supply, it makes cooking very dear between certain hours, and, in the aggregate, it is unwise to use this system.

The best compromise—for a compromise is imperative, with the cost of generation varying from hour to hour, and relatively negligible storage provided—is to supply energy for all domestic purposes at a flat rate of ½d., covering all capital expenses and the extra cost of peak supply by a fixed charge; the consumer is then no longer perplexed by variations in the price paid for a given amount of a given commodity—he obtains current for all purposes at a uniform and very low rate, and if his cook leaves the stove switches "on" an hour or so longer than she need do, the cost of the extra energy consumed is not a serious item.

So far, so good; but it is in the determination of the fixed charge that difficulties appear. The majority of existing "point five" undertakings assess fixed charges on the basis of rateable value, and it would seem that there is considerable risk of this becoming standard practice. The writer cannot believe it is desirable that this should happen, and in the following paragraphs are set out arguments which seem to him deserving of close consideration, as well as figures and curves, which appear to demonstrate conclusively that the rateable value basis is not equitable.

The most tempting feature of the rateable value tariff, from the central station point of view, is its simplicity. All houses have their rateable values assessed, and it is only necessary to take a certain percentage thereof, and charge all units at ½d., and the job is done. The fundamental assumption is that rateable value is a reasonably accurate measure of the electricity-consuming capacity of private premises, and the fundamental weakness of the system is that it is not necessarily or even generally anything of the kind. In a particular row of houses under the writer's observation, all rated at the same value, one is occupied by a family keeping two servants, and holding frequent parties, during which every room in the house is brilliantly lighted. The next house is occupied by a quiet and smaller family, burning about one-third the number of lights used by their neighbours. The next house is a boarding establishment, and the next again is occupied by eccentric persons of the daylight-saving persuasion. And so it goes on along the street in question, and, broadly, the writer ventures to suggest, all over any town.

The object and tendency of any "fixed-charge-plus-small-unit-charge" system is to encourage liberal use of electricity by all persons, but it cannot be ignored that houses of similar size and quality shelter families of very different sizes and habits, and, in fact, that rateable value bears neither theoretical nor actual relationship to the current consumption of a household.

Concrete support for this contention is to be found in fig. 1, which presents graphically some data included in the latest report of the working of "point-five" tariffs in conjunction with rateable-value fixed charges. These statistics, presented by Messrs. Blackman and Roles at the recent I.M.E.A. meeting, show the average units used per consumer during

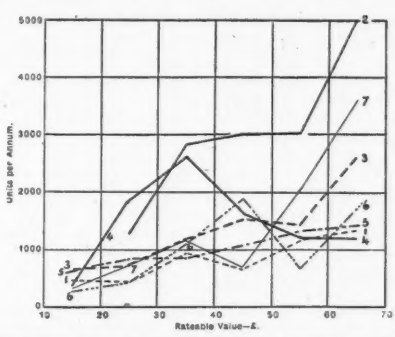


FIG. 1.—SHOWING AVERAGE UNITS PER ANNUM IN HOUSES OF DIFFERENT "R.V."

a period of 12 months by consumers having rateable values between £10 and £20; £20 and £30, and so on. In plotting the data it has been assumed that the average rateable values of the several groups are £15, £25, &c. This assumption and the fact that different numbers of consumers are included in obtaining the averages for the various groups doubtless affects the absolute accuracy of the curves, but the latter show that although there is a natural tendency for consumption to increase with rateable value, the increase is by no means smoothly progressive nor is there a reasonably constant ratio between the consumption in houses rated at, say, £25 and £55. For instance:—

RATIO UNITS PER ANNUM PER CONSUMER IN HOUSES RATED £55 : £25.

1. Barnes	2·6	5. Sunderland	1·6
2. Blackpool	2·3	6. Worcester	1·6
3. Bradford	1·9	7. Wrexham	2·8
4. Carlisle	0·65		

The numerals correspond to those on the various curve sheets.

Though, as mentioned, some part of the disparity between these figures may be due to the different number of cases averaged in various groups, that only goes to show that the rateable value in individual cases is a very poor index of current consumption. Whereas in Sunderland the rateable value percentage charge is *increased* as rateable value increases (from 10 per cent. between £15 and £30 to 15 per cent. over £70), the charge in Blackpool is normally 12½ per cent. on assessment, and is reduced to 10 per cent. on houses rated over £100.

In any event, if a different percentage of R.V. is to be charged in the case of different sized houses (as seems desirable), and if allowance is to be made for the effect of specially large or small gardens on rateable value (as seems essential), the R.V. tariff at once loses its merits of simplicity and power of being easily understood by the layman.

The method generally employed (at the time of initiating the new tariff) in determining the percentage of rateable value to be taken as the fixed charge, is to analyse previous accounts, and see what percentage of rateable value will, in

conjunction with ½d. per unit, give the same revenue from lighting as the previous flat rate (say, 4d. a unit). This amounts to securing the station's revenue and supplying all additional units at ½d. It is a simple, if tedious, method of arriving at a suitable *average* percentage on rateable value, but there is nothing to secure (1) that this percentage will not be far wide of the mark in individual cases; and (2) that the percentage decided by reference to previous accounts will be at all suitable under the new conditions which it is desired to bring about by the new tariff.

Generally the percentage charge is 10, 12½ or 15 per cent. on rateable value, but it makes a considerable difference to consumers, and so, ultimately, to the station's prospects, which percentage is adopted. To illustrate this, fig. 2 has been prepared. As a reasonable basis (averaging the general tendency of the curves in fig. 1), let us assume the following average annual consumptions for houses rated as below :—

R.V.	Units.	R.V.	Units.
£15	500	£45	1,400
25	750	55	1,800
35	1,000	65	2,200

Then, with all units at ½d. and fixed charges of 10, 12½ and 15 per cent. in turn on rateable value, the average cost per unit varies as shown in fig. 2. In this case 2½ per cent. on rateable value corresponds to about 0·2d. per unit

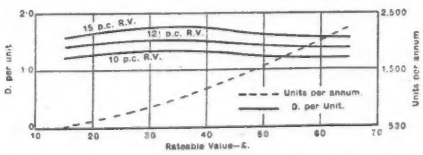


Fig. 2.—Effect of "R.V." Charge on Mean Price per Unit.

difference in mean price per unit, and hence to about 10s. per annum on the bill for a £15 house and £2 per annum on the bill for a £65 house. This difference in bill—which may easily arise due to (1) erroneous assumption of rateable value percentage applying to old conditions; (2) inapplicability of assumption to new conditions; or (3) variations in percentage rateable value properly applying to houses of different R.V.—is here about 13 per cent. on the total amount, and in the long run cannot but tell against the station's financial position or against the development of supply (according as the difference is in immediate favour of the consumer or the station).

(*To be concluded.*)

PREFERENTIAL RATES FOR EXPORTS.

By FRANK BROADBENT.

Whether we label ourselves and each other Liberal, Conservative or Radical, the fact remains that the human mind is inherently Conservative, and resists to the uttermost a change of opinion. It takes an earthquake or a world-war to shake it out of itself, and hence we find ourselves to-day calmly thinking things which a couple of years ago we should have considered almost sacrilegious. When we find erstwhile Free Traders of the staunchest type cheerfully welcoming a 33⅓ per cent. import duty on motor-cars, for example, we need not fear to ventilate the subject of preferential rates for exported articles.

To have suggested, say, a couple of years ago, that electrical manufacturers should, as a definite policy, adopt a system of preferential rates for exported goods, charging lower rates to the overseas purchaser than to the home buyer, would have raised such cries as "German methods," "dumping," and the like, and it would have been argued that the home consumer must necessarily be saddled with the losses on the export trade. It has, in fact, been seriously and consistently argued that this is the normal condition of affairs in such countries as Germany and America.

But electrical engineers who have raised the formulation of preferential tariffs for electricity supply almost to the dignity of a fine art, should have no difficulty in applying the system in one or other of its many modifications to the export or any other department of the electrical industry. The argument that, under a preferential tariff, the home consumer pays for the losses on overseas trade, is practically the same as that of the lighting consumer who protests that he bears the losses on the sale of cheap units to the power consumer. This argument, based as it is upon the false assumption that all units generated have an equal value, does not at this time of day call for serious treatment. The justification of the policy lies in the fact that the development of the power load has resulted in a general lowering of lighting rates due to the all-round reduction in standing charges per unit sold.

Having accepted and approved of the principle of differentiation when applied to the supply of electricity, we cannot logically object to it when applied to the supply of any other electrical commodity. We are therefore justified, from a business point of view, in regarding the home trader as the lighting consumer, and the overseas trader as the power consumer, and just as a discriminating tariff policy has resulted in an enormous increase in the electric supply business and a lowering of costs all round, so we may assume that if scientifically adapted it should have a similar effect in manufacturing industries generally, and help towards securing a very much larger share of the export trade than we have hitherto enjoyed.

In addition, however, to costs of manufacture, there are, in dealing with export matters, the questions of railway charges and freight to consider; but it should not be impossible to apply some modification of the system of electricity supply tariffs even to these.

We have a system of charging known as the "telephone" system, which might be just as accurately described as the parcel-post system. In the latter, according to the new Budget, we shall pay 4d. a lb. for the first lb. and 1d. for each additional lb. carried. This is not quite the best statement of the method of charging, which is more accurately expressed by saying that the rate of charge is 1d. per lb., plus 3d. per package for standing charges. The bulk of the parcels for long-distance transmission are carried by the railway companies, the short distances being dealt with by the P.O. motor vans. The average price paid by the general public for small packages carried on the railways and delivered to their destination is approximately 1d. per lb. for any distance within the United Kingdom. Presumably it pays the railway companies.

There is no hard-and-fast rate for goods traffic, the price depending upon the character and quantity of the goods, and the distance to be covered; but it should be possible for an association of manufacturers—the B.E.A.M.A., for example—who could guarantee a minimum amount of traffic per annum, to secure much better rates than those at present in vogue. By a system of co-operation it might be possible for the manufacturers in certain areas to fill a certain number of truckloads for each outgoing steamer from the nearest port, and in this way get rates for truckloads instead of rates per cwt. or per ton. Then a sliding scale of discounts depending on the quantity shipped per annum might be arranged, the quantity being the aggregate of the individual shipments of the members of the group.

The question of freight is more difficult, because lines of steamers to various foreign ports are controlled by certain combinations of shipowners who, in the absence of any competition, are in a position to make their own terms. Moreover, the rates vary with the demand for ships. There is certainly scope for improvement from the exporter's point of view, but as the method of charging is practically standardised throughout the world, it would need a world-wide movement among shippers to secure any improvement. That better terms *can* be obtained is proved by the success of the Government in connection with the meat contracts. To illustrate one only of the disadvantages under which the exporter labours, take the case of a manufacturer who exports motors and arc lamps to the Colonies, say, Australia. Four arc lamps, with their globes, weighing, say, 4½ cwt., including cases, would measure about 60 cb. ft., and would, therefore, on a measurement basis, be charged for as if they weighed 1½ tons. At 40s. a ton (pre-war rate) this would amount to £3, or, approximately, 10 per cent. of the total value of the goods. In the same sized case a motor weighing 1½ tons could be packed, costing about three times as

much as the arc lamp consignment. The cost of freight would be about the same. Each package is rated separately, that is to say, if one package measures 40 cb. ft., and weighs ½ ton, it is charged for as 1 ton, whereas another package of the same size, weighing 1½ tons, would be charged for as 1½ tons. The consignor, therefore, would pay freight on 2½ tons, although either by weight or by measurement the two packages, taken together, are only 2 tons.

It does not seem quite equitable that an exporter should not be able to average the weights and measurements of several cases. Moreover, if he tries to economise by packing several things in one case, and so getting an average value, he may find himself charged at a higher rate for exceeding a weight limit.

In the meantime, the only thing an exporter can do is to study the question of packing very carefully with a view to reducing his measurements to a minimum, remembering that an external stiffening batten, or a projecting bolt, may easily add 10 per cent. to the measurement and freight of a small case.

TRADE STATISTICS OF SOUTH AFRICA.

The following statement, showing the imports of electrical and similar goods into the Union of South Africa during the year 1914, has been taken from the recently issued official trade statistics. The figures for 1913 are added for purposes of comparison, and notes of any increases or decreases are given.

	1913. £	1914. £	Inc. or dec. £
Asbestos manufactures.—			
From Great Britain ...	4,000	3,000	– 1,000
,, Other countries ...	4,000	3,000	– 1,000
Total	8,000	6,000	– 2,000
Brass manufactures.—			
From Great Britain ...	31,000	26,000	– 5,000
,, Germany	2,000	1,000	– 1,000
,, Other countries ...	2,000	2,000	—
Total	35,000	29,000	– 6,000
Copper, plate and sheet.—			
From Great Britain ...	4,000	3,000	– 1,000
,, Other countries ...	1,000	1,000	—
Total	5,000	4,000	– 1,000
Copper manufactures.—			
From Great Britain ...	5,000	4,000	– 1,000
,, Other countries ...	2,000	—	– 2,000
Total	7,000	4,000	– 3,000
Electrical cable and wire.—			
From Great Britain ...	170,000	173,000	+ 3,000
,, Germany	71,000	18,000	– 53,000
,, Other countries ...	10,000	3,000	– 7,000
Total	251,000	194,000	– 57,000
Electrical fittings, including posts.—			
From Great Britain ...	155,000	157,000	+ 2,000
,, Germany	67,000	40,000	– 27,000
,, Holland	3,000	3,000	—
,, United States ...	30,000	22,000	– 8,000
,, Other countries ...	9,000	10,000	+ 1,000
Total	264,000	232,000	– 32,000
India-rubber of all kinds.—			
From Great Britain ...	29,000	27,000	– 2,000
,, Germany	3,000	3,000	—
,, United States ...	3,000	3,000	—
,, Other countries ...	1,000	1,000	—
Total	36,000	34,000	– 2,000
Lamps and lampware.—			
From Great Britain ...	19,000	16,000	– 3,000
,, Germany	21,000	11,000	– 10,000
,, United States ...	15,000	12,000	– 3,000
,, Other countries ...	3,000	2,000	– 1,000
Total	58,000	41,000	– 17,000
Machine bands and belting.—			
From Great Britain ...	100,000	87,000	– 13,000
,, United States ...	37,000	34,000	– 3,000
,, Other countries ...	4,000	4,000	—
Total	141,000	125,000	– 16,000
Electrical machinery.—			
From Great Britain ...	142,000	178,000	+ 36,000
,, Germany	253,000	168,000	– 85,000
,, United States ...	51,000	83,000	+ 32,000
,, Other countries ...	5,000	5,000	—
Total	451,000	434,000	– 17,000
Cranes, elevators and lifts.—			
From Great Britain ...	45,000	31,000	– 14,000
,, United States ...	11,000	3,000	– 7,000
,, Other countries ...	7,000	1,000	– 6,000
Total	63,000	35,000	– 28,000
Mining machinery.—			
From Great Britain ...	512,000	460,000	– 52,000
,, Germany	74,000	60,000	– 14,000
,, United States ...	161,000	155,000	– 6,000
,, Other countries ...	19,000	28,000	+ 9,000
Total	766,000	703,000	– 63,000
Machinery not specially mentioned (other than agricultural, manufacturing, etc.).—			
From Great Britain ...	341,000	328,000	– 13,000
,, Germany	39,000	23,000	– 16,000
,, United States ...	39,000	28,000	– 11,000
,, Other countries ...	8,000	10,000	+ 2,000
Total	427,000	389,000	– 38,000
Railway rails.—			
From Great Britain ...	13,000	5,000	– 8,000
,, Belgium	1,000	1,000	—
,, Germany	61,000	67,000	+ 6,000
,, United States ...	4,000	5,000	+ 1,000
Total	79,000	78,000	– 1,000
Telegraph and telephone material.—			
From Great Britain ...	10,000	9,000	– 1,000
,, Germany	1,000	1,000	—
,, Sweden	3,000	2,000	– 1,000
,, United States ...	1,000	1,000	—
,, Other countries ...	3,000	2,000	– 1,000
Total	18,000	15,000	– 3,000
Tramway rails.—			
From Great Britain ...	2,000	2,000	—
,, Germany	14,000	7,000	– 7,000
,, United States ...	5,000	4,000	– 1,000
,, Other countries ...	—	1,000	+ 1,000
Total	21,000	14,000	– 7,000
Tramway rolling-stock.—			
From Great Britain ...	16,000	19,000	+ 3,000
,, United States ...	12,000	2,000	– 10,000
Total	28,000	21,000	– 7,000
Other tramway materials.—			
From Great Britain ...	11,000	12,000	+ 1,000
,, Germany	1,000	2,000	+ 1,000
,, United States ...	5,000	5,000	—
Total	17,000	19,000	+ 2,000

In addition to the above the following goods were imported as "Government Stores":—

Brassware.—			
From United Kingdom ...	8,000	3,000	– 5,000
Copper, plate and sheet.—			
From United Kingdom ...	20,000	14,000	– 6,000
Electrical cable and wire.—			
From United Kingdom ...	63,000	49,000	– 14,000
Electric fittings.—			
From United Kingdom ...	24,000	6,000	– 18,000
,, Germany	2,000	500	– 1,500
,, Other countries ...	1,000	1,000	—
Total	27,000	7,500	– 19,500
India-rubber.—			
From United Kingdom ...	4,000	6,000	+ 2,000
Lampware.—			
From United Kingdom ...	4,000	4,000	—
Cranes and elevators.—			
From United Kingdom ...	25,000	14,000	– 11,000
Electrical machinery.—			
From United Kingdom ...	12,000	9,000	– 3,000

	1913. £	1914. £	Inc. or dec. £
Other machinery.—			
From United Kingdom ...	56,000	38,000	– 18,000
,, Other countries ...	4,000	4,000	—
Total	60,000	42,000	– 18,000
Railway rails.—			
From United Kingdom ...	388,000	367,000	– 21,000
,, Germany	—	10,000	+ 10,000
,, Canada	—	177,000	+ 177,000
Total	388,000	554,000	+ 166,000
Telegraph and telephone material.—			
From United Kingdom ...	125,000	103,000	– 22,000
,, Sweden	31,000	36,000	+ 5,000
,, Other countries ...	1,000	1,000	—
Total	157,000	140,000	– 17,000

ARC PHENOMENA.

By A. G. COLLIS.

(Abstract of paper read at the Panama Pacific Convention of the American Institute of Electrical Engineers, San Francisco, Cal., September 16th, 1915.)

One of the most important fields of science is that which deals with "arc phenomena" occasioned by the duties of switchgear, which form such important links of an electrical transmission. In my previous publications there are oscillograph records of the effects produced by opening moderate currents and voltages, such as are met with in every day practice. This paper deals with investigations on critical phenomena obtained from circuits of much larger dimensions.

Herewith are illustrations obtained by photographing the arc formed by opening a.c. circuits under oil, and attention is directed to their various shapes caused by special forms of contacts.

For the purposes of these experiments the same switch was used in every case, fitted with different contacts as shown below. The photographs were obtained by using a camera

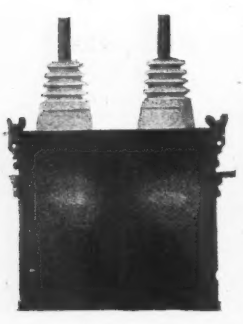


Fig. 1.

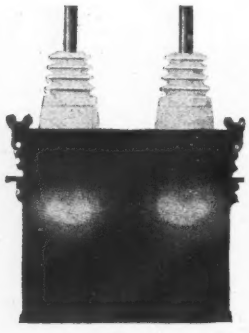


Fig. 3.

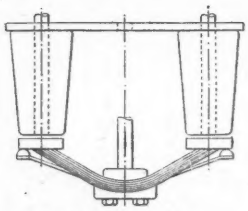


Fig. 2.—Brush Laminated.

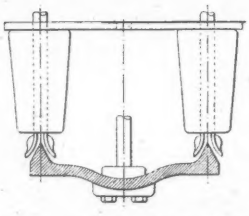


Fig. 4.—Solid Wedge Form of Contact.

and intensifier, the shutter of which was directly connected to the operating mechanism of the switch, one side of the switch case being fitted with a transparent flexible partition revealing the arc disturbance.

Fig. 1 illustrates the arc formed by rupturing a non-inductive 3-phase circuit, 6,600 volts, 200 amperes, (r.m.s.) at unity power factor. The oil switch contacts (fig. 2) operated in a vertical plane, the total length of break being 10½ in. per phase. It will be observed that the shape of the arc is an ellipse, its greater diameter being directed horizontally towards the sides of the tank. In nearly all the cases of switch bursts that have come under my personal observation, the damage is more apparent on the sides of the oil tank, following the direction of the flow of the current. Front or back explosions are not so prominent, which may, of course, be due incidentally to the relative positions of the arc contacts, and it is for this reason that the photo plate produces the shape of the arc where it was felt its effect would be most severe. The shape of the arc follows the shape of the arcing contacts, and there is no doubt that the disturbances following rupture are directly related to the shape of arc contacts as will be commented upon later.

Fig. 3 illustrates the formation of the arc, in oil, by rupturing a 3-phase 6,600-volt, 220-ampere (r.m.s.) inductive circuit at 0.9 power factor. The contacts used in this case were of the well-known "wedge" form, fig. 4. The rupture in this case is slightly more severe than in the case of fig. 1, and the arc is slightly larger. The pressure in lb. per square inch was 75, as per table herewith. It will be understood that the

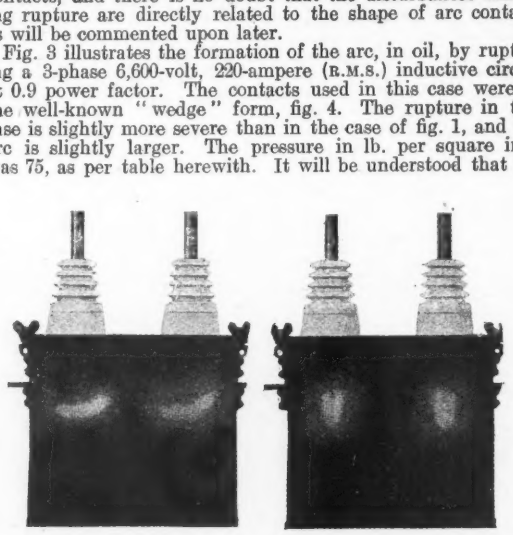


Fig. 5.

Fig. 7.

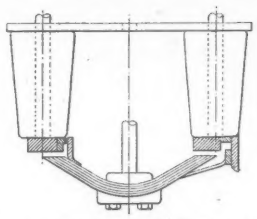


Fig. 6.—Brush Contact with Trailing Pieces Inside and Outside.

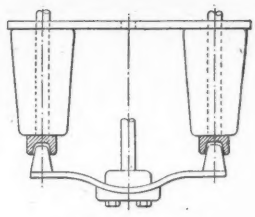


Fig. 8.—Cone Contacts.

effects of explosion depend to a certain extent on the position of the wave at the time of opening. No oscillograph tests were taken at the time when the photo plate was exposed to the arc. The tendency of the arc in this case is to turn upwards when directed outwards, and it is of the "heart shape" variety. Several designers, in order to quench the arc more effectively, have used artificial "arc dampers" placed in a diagonal direction over the forces of explosion to press the oil over the neighbourhood of the rupture zone, from which it would appear that they conjectured that the greatest strain during the rupture appeared in this region. These illustrations confirm this opinion. On the other hand, some engineers appear to consider that the arc damping fluid should be forced on the rupture zone from the vertical position, *i.e.*, directly over the centre of the disturbed area. The result of this method is shown in fig. 5, which illustrates the arc made by breaking a similar circuit 180 amperes (r.m.s.) at 6,600 volts, 0.83 power factor. The form of contact used (see fig. 6) is the brush form, as in fig. 1, but fitted with vertical trailing arc pieces. It will be observed that the arc pieces were fixed at the side of the main contacts, one inside and the other outside. These arcing pieces were placed in this position for the purpose of observing whether the arc phenomena followed a natural sequence or if its artificial creation was caused by the individual shape and character of the contacts. It would appear, as shown in the illustration, that the arc is influenced by the construction of the trailing pieces. It will be observed that the natural formation of an arc can be artificially directed and modified by contact design, considerably increasing or decreasing the capacity of switches of limited rupturing capacity. Thus a switch with one form of contact and a rupturing capacity of, say, 10,000 k.v.a., might be so reconstructed and modified as to have its capacity increased to 15,000 k.v.a. There is no doubt that the direction of the explosive forces produced by the arc is related to its power to withstand heavy duties, the shape and position of the "arc trailers" having a relative bearing on its formation.

Fig. 7 illustrates the arc formed by breaking circuit with the cone contacts, fig. 8, the shape of the arc being of the "filbert character," showing the maximum force divided along a vertical plane. This class of contact is not so much in common use as those shown in figs. 2 and 4. The shape of the arc is more ideal and the rupturing capacity of the switch increased over those of its neighbours in comparison. The circuit ruptured in this case had a practically non-inductive load of 125 amperes (r.m.s.) at 6,600 volts, unity power factor. Thus the arc should be smaller in dimensions than those preceding it. Auxiliary arc dampers were provided with this switch, forcing the oil in a downward direction towards the

seat of the explosion. The effects of these are shown in the illustration. For very heavy rupturing capacities, "arc dampers" are considered necessary, and will be commented upon later.

Fig. 9 illustrates the arc formed by breaking a circuit of 300 amperes (R.M.S.), 6,600 volts, power factor approximately unity. The arcing contacts are shown in fig. 10 and are known as the double-brush type, the oil being forced over the centre of the arc zone. The illustration shows the effects of this feature. The increasing diagonal forces as interpreted from the shape of the arc structure, with the maximum strain directed towards the sides of the oil tank, are also shown. This type of contact was introduced very successfully on a 20,000-volt transmission, but the tendency is now to use an entirely different form of design for high-tension electrical transmissions.

Fig.	Amps.	Volts.	Lb. per sq. in. near arcs.	Lb. per sq. in. 2½ in. from contacts.
1	200	6,600	74	70
3	220	6,600	75	63
5	180	6,600	68	65
7	125	6,600	54	32
9	300	6,600	78	71

The pressures in pounds per square inch surrounding the arc area are given above. These pressures were obtained by inserting in the tank an operating cam, directly connected to an external indicating instrument, as used for hydraulic testing, the instrument being specially calibrated to record pressures in the oil tank.

Fig. 11 shows the distance rate of change declinations of forces directed toward the sides of the oil can resulting from various arc forms. The steeper the inclination of this characteristic, the greater the rupturing capacity of the switch.

As shown by the above illustrations, the pressure and formation of the arc is the critical point of an oil switch, and designers should concentrate their energies on the effective harnessing of its explosive features.

There exists a hypothesis that an arc ruptured in oil is immediately damped out by the oil rushing between the contacts, and intercepting the current flow at the zero point.

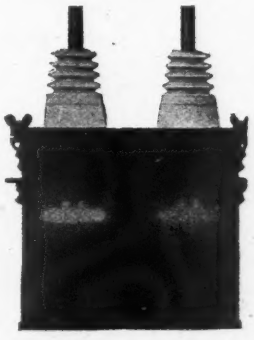


Fig. 9.]

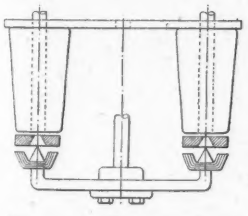


Fig. 10.—Hollow Conductor for Oil Brush Contacts.

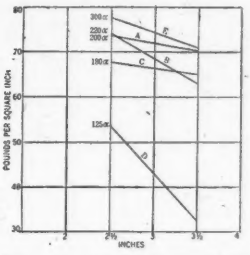


Fig. 11.—Diagram showing Decline of Forces in Various Arcs.

An analysis of the above proves that this is not the case. The formation of the arc sets up a vaporised space around the contacts, the intensity of which is proportional to the volume of force liberated; this prevents the oil (which is of a somewhat sluggish character) entering the space around the contacts. When the arc vapour is dissipated or approaches its extinguishable value by a decrease in the current, the oil is permitted to flow over the disturbed space.

It is obvious that a circuit in a dangerous condition should be relieved as quickly as possible, but such a circuit having appreciable inductance, if rapidly opened, may give rise to abnormal potential stresses, which may reach a value seven times the normal.

Oscillograph records already published show a current increment on short circuit at the rate of 850,000 amperes per second, but if a short circuit can be disconnected before the current reaches a dangerous value, the rise of pressure may not be excessive even with a rapid break. Thus the instantaneous opening of a short circuit does not necessarily interpose abnormal potentials.

The opening of a switch follows the period of maximum disturbance, and a certain amount of time must elapse before the circuit can be disconnected. The time taken by a positive relay for automatically tripping the switch averages 0.4 second. The time occupied by a gravity oil switch with a 5-in. break per pole per phase averages 0.6 second, so that, in all, the switch reaches the off position in a second. The time elapsed between the parting of the main and auxiliary contacts (assuming brush contacts) averages 0.2 second. By multiple breaks the rapidity of interrupting a circuit may be correspondingly increased, and for heavy duty at high pressures the multiple break is becoming a necessity.

Engineers have experienced considerable inconvenience by the appearance of surges when closing high-potential circuits. Flash-overs and breakdowns in some installations have been more frequent with the closing of the circuits than those produced when opening the supply. A series of experiments were carried out on a large power supply system in the Midlands by installing a series of earthed spark gaps on the end turns of a 500-KW. 6,600-volt slow-speed motor. These spark gaps were adjusted to flash over at definite voltages. When the results were plotted, a pressure of 27,000 volts was recorded by closing the overhead mains four miles long, while connecting this machine on to the circuit before starting up.

WAR ITEMS.

The Unassuming Hun.—"One of the principal reasons why the Germans covet as a permanent possession that portion of Northern France which they now occupy is its wealth in coal and iron, and it is clear that long before the declaration of war they were plotting, by their usual methods of spying and deceit, to seize the French ironworks at the earliest opportunity and turn them to account for their own benefit. An instance of how craftily this plan was pursued is given in our French contemporary 'l'Usine.' Within a stone's throw of the German frontier in Lorraine are the great French steelworks of Homécourt, the owners of which control a considerable part of the famous Briey ironstone mines. About fifteen years ago there came to the Homécourt works a retired officer of the German Navy, who had settled in Luxemburg and had been naturalised in that Duchy. He applied for employment as an engineer, and as he showed himself possessed of much technical knowledge and was no longer of German nationality, he was given a situation. The ex-German proved a veritable treasure. He was discreet, energetic, devoted to his work, and showed himself an excellent intermediary between Homécourt and the German works on the other side of the border with which his employers maintained close business relations. Not being a Frenchman he had no prospect of advancement to the higher posts in the company, and his salary remained modest, but this he did not seem to mind, and by degrees he passed through various departments of the works and acquired a thorough knowledge of them all. On July 30th a large number of the workmen at Homécourt left to join the French Army. On the same day, twenty-four hours before the actual declaration of war, the Germans crossed the frontier, seized Homécourt, and installed there a staff and workmen from their own side of the border. On Monday, August 3rd, the Homécourt steelworks started 'business as usual'—except that they were now a German factory, with the ex-German officer, in full uniform, installed as general manager. The ingenious gentleman's local knowledge has since proved of the greatest value to the invaders. One wonders whether there are any energetic, discreet and modest ex-Germans engaged in peaceful pursuits in this country who, in the event of an invasion of these islands, would promptly get into their old uniforms and convert themselves into business-managers for the invaders?"—"Ironmonger."

Exports to China and Siam During the War.—The "London Gazette" for September 24th contains a proclamation relating to the exportation of all articles to China and Siam during the war. The proclamation prohibits the exportation of all or any of the following articles:—"Arms, ammunition, military and naval stores, and any article which We shall judge capable of being converted into or made useful in increasing the quantity of arms, ammunition or military or naval stores to any country or place therein named whenever We shall judge such prohibition to be expedient, in order to prevent such arms, ammunition, or military or naval stores being used against Our forces or against any forces engaged or which may be engaged in military or naval operations in co-operation with Our Forces." The exportation of any such article as comes under the proclamation to any such country or place is prohibited unless consigned to persons authorised to receive it. A lengthy list follows of persons and bodies of persons to whom articles may be consigned.

Australia and Munitions.—The Australasian Government is forming an Industrial Corps, in which will be enrolled skilled mechanics and other workers for the manufacture of munitions and equipment. Among other articles they will make will be scientific apparatus, engineering parts, field wireless sets, and telephone equipment.

London's Restricted Lighting.—In reply to questions asked in the House of Commons last week, on the question of lighting regulations and air raids, Sir John Simon said that the regulations for lighting in the Metropolitan area, with a view to minimising risk from air raids, had been most carefully studied by expert officers of the Admiralty, and the scheme adopted by the Home Office and the Police Authorities was based on their advice, and was the result of repeated observations alike from the air and the ground. The main object to be aimed at was uniformity rather than absolute darkness, and it was a matter of great importance that the scheme should be applied equally in all parts of this area, exceptional darkness being as likely to prove a distinctive mark as exceptional brightness. Private citizens and local authorities had shown themselves generally willing to accept the application of the scheme and the lighting orders made to give effect to it, but as some cases of local departure from the scheme had come to his notice he was proposing to make a fresh order defining more exactly some of the requirements, as, for instance, in the matter of the lights in private houses and giving the police increased power to enforce it. On Tuesday this week Sir John announced that he was making the following order:—"Bright lights in hotels, flats, dwelling-houses, and premises of all descriptions not coming under the other provisions of this order must be shaded or windows screened, so that no bright light is cast in any direction outside." This will apply to bright lights visible from the rear of houses no less than to those visible from the front.

The Lighting of Armentières.—A correspondent sends us a letter received from a friend "On Active Service," in which the following remarks appear:—"Quite a good story has been told here. The facts of the case must be known to the enemy by now, so I presume it is giving nothing away for me to mention the details. The time dates back to the occasion when the Germans first occupied Lille while our troops occupied Armentières. On entering Lille, the Germans soon discovered the electric light works, and, of course, were not long in getting them into operation. They supplied themselves with electric light and, naturally, such an asset they made the worst of, for in a war area such a commodity must be 'some' capture. Thus they went on for two or three months in utter ignorance of the fact that, in addition to facilitating their own work, they were obliging the British military authorities, for Armentières was supplied with electric light and power from the same works. In point of fact, a farmhouse adjacent to the end of one of our communication trenches was so supplied until the Germans found out their colossal 'bloomer.'"

Australian Inventions.—The State Cabinet has decided to appoint a Patents Investigation Committee to assist in the development of inventions likely to be of general public utility. Any ideas which, after investigation, the board is of opinion are of value to the public will be submitted by it to the various public departments likely to be able to utilise them.

Royal Engineers.—In reply to a Parliamentary question as to whether an application was made in July by his Department to the Institution of Civil Engineers to procure for them officers for the Royal Engineers who had a knowledge of heavy construction work, Mr. Tennant stated last week, according to the "Times," that the statement was substantially accurate, and the result had been that 19 gentlemen had already received commissions in the R.E., and the consideration of the qualifications of others was proceeding with a view to the filling of further vacancies which might occur.

Trade Openings in Italy.—From the British Chamber of Commerce for Italy, in Genoa, we have received List No. 22 of openings for British articles in Italian markets, from which we give a selection below. Many of these firms formerly did business with German and Austrian houses, and now seek British connections:—

No. 919.—Agent at Genoa wishes to hear from British manufacturers of tools, machine tools, machinery, hardware, etc.—G.G.R.

No. 921.—Manufacturers of lamps, etc., at Marrare, wish to buy lamp glasses, globes, etc., general fittings and supplies for lighting.—F.S.S.

No. 930.—Merchants at Turin are open to buy (and would, after trying the goods, be disposed to accept agency) flies, steel wire and steel sheets, machine tools, wood-working machinery, tools, drills, metal-working machinery. Branches at Milan, Genoa and Rome.—T.J.T.

No. 931.—Agent at Rome would buy for own account, or sell on commission with delcredere, electrical materials and machinery. Represented Berlin firm for 14 years; well introduced.—R.D.P.

No. 936.—Forwarding agents at Genoa, having opened a department for the representation of foreign firms, and having their own travellers, are anxious to hear from British manufacturers and shippers of raw materials for industry and articles of any sort.—G.C.P.

No. 939.—Engineer at Rome seeks agencies for Italy in building materials, iron girders, electric lighting material.—R.N.G.

The German War Loan.—After referring to a few examples of the "compulsory" applications of workers for the German war loan, the Central News correspondent at Zurich (according to the "Financial Times") quotes the following as an instance of how foreign, including British, capital lying in Germany is being drawn on for war loan purposes:—An international trading firm in which there are many English shareholders, and which has a large establishment in England, had delivered goods in Germany before the war from Holland to the value of 140,000 marks. This money was lying in German banks when the war broke out, and as it cannot be taken out of the country without heavy loss on exchange the only resource left to the Dutch directors, in their view at least, has been to invest the money in the war loan.

Iron and Steel Institute and Alien Enemy Members.—At the autumn meeting of the Institute last week the following new rules were adopted:—(1) In the event of a state of war existing between Great Britain and any other country or State, all members, honorary members, and honorary vice-presidents who shall be subjects of such enemy country or State shall forthwith cease to be members, honorary members, or honorary vice-presidents of the Institute, but they shall be eligible for election after the war in the usual manner. (2) The Council shall have absolute power to remove from the list of members of the Institute the name of any member, whether ordinary or honorary, for wilful contravention of the by-laws, or for any other reason which seems to them sufficient, and such ordinary or honorary member shall thereupon cease to be a member of the Institute.

NEW PATENTS APPLIED FOR, 1915.

(NOT YET PUBLISHED).

Compiled expressly for this journal by Messrs. W. P. Thompson & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

13,051. "Replaceable electrical safety fuses." W. J. John. September 13th. (Complete.)

13,062. "Electric absorbers for pendants, stand lamps, and the like." S. Quincey. September 13th.

13,079. "Means for regulating arc lamps." J. Brockie. September 13th.

13,080. "Projector arc lamps." J. Brockie. September 13th.

13,110. "Portable electric writing-lamp." F. Summerfield. September 14th.

13,129. "Arrangement for producing short unidirected high-tension current impulses." W. Otto. September 14th. (Complete.)

13,137. "Shaft bearings." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). September 14th.

13,145. "Apparatus for cutting down wire entanglements, telephone and telegraph or other wires from a distance, also applicable for grappling purposes." J. W. Defries. September 14th.

13,207. "Alloys." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). September 15th.

13,216. "Electrical methods for sounding church and other bells." T. L. Southgate. September 16th.

13,220. "Electrical terminal." R. W. Paul. September 16th.

13,271. "Contact breakers for internal-combustion engines." W. G. Gray. September 17th.

13,283. "Means for regulating the output of dynamo-electrical machines driven at variable speeds." N. E. Dufty. September 17th.

13,286. "Method of manufacturing gear wheels." British Thomson-Houston Co., Ltd. (General Electric Co., U.S.A.). September 17th.

13,287. "Dynamo-electric machines." A. H. Neuland. September 17th. (Complete.)

13,294. "Connections for electrical conduits." O. J. Nilsen and C. T. Cromie. September 17th.

13,329. "Appliance attachable to a rifle, a pole, or the like for grappling and cutting down wire entanglements, telephone and telegraph or other wires." J. W. Defries. September 18th.

PUBLISHED SPECIFICATIONS.

1914.

12,910. Method for Generating High-frequency Electric Currents. C. Hoegerstaedt & Tempest. May 26th.

19,191. Holders for Electric Incandescent Lamps. St. Helens Cable and Rubber Co. & J. C. White. August 28th.

19,237. Mechanism for Printing-telegraph Systems. E. C. R. Marks (Morkrum Co., U.S.A.). August 29th.

19,319. Electric Connections. S. F. Tyler & W. J. E. Beere. September 1st.

19,322. Electromagnetic Percussive Devices. J. W. Mackenzie (International Electric Tool Co.). September 1st.

21,368. Electric Contact Breakers or Interruptors. G. F. Cooke. October 22nd.

23,881. Electric Connections for Resistance Bodies. British Thomson-Houston Co. (General Electric Co., U.S.A.). December 10th.

1915.

641. Current-interrupting Devices for Magneto-ignition Apparatus. M. S. Conner. January 15th.

1,275. Pocket Electric Flash Lights. W. J. Mellersh-Jackson (Posen). January 26th. (Addition to 18,809/14.)

2,490. Starting means for Electric Motors. W. J. Sheppard & G. A. Yarwood. February 16th.

3,284. Electric Motor Control Systems. Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co., U.S.A.). March 1st.

4,747. Electric Motor Control Systems. Igranic Electric Co., Ltd. (Cutler-Hammer Manufacturing Co., U.S.A.) March 26th.

4,748. Electric Circuit Controllers of the Drum Type. G. R. Radley. March 26th. (March 30th, 1914.)

5,994. Sound Transmitter. C. Still. April 21st.

7,510. Devices for Adjustably Suspending Electric and other Lamps, Electroliers, Gas Pendants, and other objects. W. H. Sturge. May 19th.

8,180. Three-way Electric Switch for Projectors and the like. Robert Bosch (firm of). June 2nd. (February 18th, 1915.)

8,189. Accumulator Cases for Motor Vehicles. P. A. H. Mossay. June 2nd.